# AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

# The NASA STI Program Office . . . in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.

- TECHNICAL MEMORANDUM. Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.

- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.

- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.

- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.

- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at *http://www.sti.nasa.gov*

- E-mail your question via the Internet to help@sti.nasa.gov

- Fax your question to the NASA STI Help Desk at (301) 621-0134

- Telephone the NASA STI Help Desk at (301) 621-0390

- Write to:
  NASA STI Help Desk
  NASA Center for AeroSpace Information
  7121 Standard Drive
  Hanover, MD 21076-1320

# Introduction

This supplemental issue of *Aeronautical Engineering, A Continuing Bibliography with Indexes* (NASA/SP—1998-7037) lists reports, articles, and other documents recently announced in the NASA STI Database.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.

The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section.

Two indexes—subject and author are included after the abstract section.

# *SCAN Goes Electronic!*

If you have electronic mail or if you can access the Internet, you can view biweekly issues of *SCAN* from your desktop absolutely free!

*Electronic SCAN* takes advantage of computer technology to inform you of the latest worldwide, aerospace-related, scientific and technical information that has been published.

No more waiting while the paper copy is printed and mailed to you. You can view *Electronic SCAN* the same day it is released—up to 191 topics to browse at your leisure. When you locate a publication of interest, you can print the announcement. You can also go back to the *Electronic SCAN* home page and follow the ordering instructions to quickly receive the full document.

Start your access to *Electronic SCAN* today. Over 1,000 announcements of new reports, books, conference proceedings, journal articles...and more—available to your computer every two weeks.

*Timely*
*Flexible*
*Complete*
*FREE!*

For Internet access to *E-SCAN*, use any of the following addresses:

> **http://www.sti.nasa.gov**
> **ftp.sti.nasa.gov**
> **gopher.sti.nasa.gov**

To receive a free subscription, send e-mail for complete information about the service first. Enter **scan@sti.nasa.gov** on the address line. Leave the subject and message areas blank and send. You will receive a reply in minutes.

Then simply determine the SCAN topics you wish to receive and send a second e-mail to **listserve@sti.nasa.gov**. Leave the subject line blank and enter a subscribe command in the message area formatted as follows:

**Subscribe <desired list> <Your name>**

For additional information, e-mail a message to **help@sti.nasa.gov**.

Phone: (301) 621-0390

Fax: (301) 621-0134

Write:  NASA STI Help Desk
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

**Looking just for *Aerospace Medicine and Biology* reports?**

Although hard copy distribution has been discontinued, you can still receive these vital announcements through your *E-SCAN* subscription. Just **subscribe SCAN-AEROMED** in the message area of your e-mail to **listserve@sti.nasa.gov**.

*New Feature!*
*subscribe SCAN-AEROMED*

# Table of Contents

Records are arranged in categories 1 through 19, the first nine coming from the Aeronautics division of *STAR,* followed by the remaining division titles. Selecting a category will link you to the collection of records cited in this issue pertaining to that category.

# Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also view the indexes provided, for searching on *NASA Thesaurus* subject terms and author names.

Selecting an index above will link you to that comprehensive listing.

# Document Availability

Select **Availability Info** for important information about NASA Scientific and Technical Information (STI) Program Office products and services, including registration with the NASA Center for AeroSpace Information (CASI) for access to the NASA CASI TRS (Technical Report Server), and availability and pricing information for cited documents.

# The New NASA Video Catalog is Here!

## Free!

To order your Free copy,
call the NASA STI Help Desk at
(301) 621-0390,
fax to
(301) 621-0134,
e-mail to
help@sti.nasa.gov,
or visit the NASA STI Program
homepage at
http://www.sti.nasa.gov
*(Select STI Program Bibliographic Announcements)*

## Explore the Universe!

# Document Availability Information

The mission of the NASA Scientific and Technical (STI) Program Office is to quickly, efficiently, and cost-effectively provide the NASA community with desktop access to STI produced by NASA and the world's aerospace industry and academia. In addition, we will provide the aerospace industry, academia, and the taxpayer access to the intellectual scientific and technical output and achievements of NASA.

## Eligibility and Registration for NASA STI Products and Services

The NASA STI Program offers a wide variety of products and services to achieve its mission. Your affiliation with NASA determines the level and type of services provided by the NASA STI Program. To assure that appropriate level of services are provided, NASA STI users are requested to register at the NASA Center for AeroSpace Information (CASI). Please contact NASA CASI in one of the following ways:

E-mail: help@sti.nasa.gov
Fax: 301-621-0134
Phone: 301-621-0390
Mail: ATTN: Registration Services
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

## Limited Reproducibility

In the database citations, a note of limited reproducibility appears if there are factors affecting the reproducibility of more than 20 percent of the document. These factors include faint or broken type, color photographs, black and white photographs, foldouts, dot matrix print, or some other factor that limits the reproducibility of the document. This notation also appears on the microfiche header.

## NASA Patents and Patent Applications

Patents and patent applications owned by NASA are announced in the STI Database. Printed copies of patents (which are not microfiched) are available for purchase from the U.S. Patent and Trademark Office.

When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, by money order or check payable to the Commissioner of Patents and Trademarks. Prepaid purchase coupons for ordering are also available from the U.S. Patent and Trademark Office.

NASA patent application specifications are sold in both paper copy and microfiche by the NASA Center for AeroSpace Information (CASI). The document ID number should be used in ordering either paper copy or microfiche from CASI.

The patents and patent applications announced in the STI Database are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

> National Aeronautics and Space Administration
> Associate General Counsel for Intellectual Property
> Code GP
> Washington, DC 20546-0001

## Sources for Documents

One or more sources from which a document announced in the STI Database is available to the public is ordinarily given on the last line of the citation. The most commonly indicated sources and their acronyms or abbreviations are listed below, with an Addresses of Organizations list near the back of this section. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source.

Avail:  NASA CASI. Sold by the NASA Center for AeroSpace Information. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code following the letters HC or MF in the citation. Current values are given in the NASA CASI Price Code Table near the end of this section.

*Note on Ordering Documents: When ordering publications from NASA CASI, use the document ID number or other report number. It is also advisable to cite the title and other bibliographic identification.*

Avail:  SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy.

Avail:  BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)

Avail:  DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in Energy Research Abstracts. Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center—Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail:  ESDU. Pricing information on specific data, computer programs, and details on ESDU International topic categories can be obtained from ESDU International.

Avail:  Fachinformationszentrum Karlsruhe. Gesellschaft für wissenschaftlich-technische Information mbH 76344 Eggenstein-Leopoldshafen, Germany.

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, CA. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration (JBD-4), Public Documents Room (Room 1H23), Washington, DC 20546-0001, or public document rooms located at NASA installations, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

Avail: NTIS. Sold by the National Technical Information Service. Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) are available. For information concerning this service, consult the NTIS Subscription Section, Springfield, VA 22161.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from Dissertation Abstracts and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.

Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of $1.50 each, postage free.

Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INlS) representative in their country, or by applying directly to the issuing organization.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed on the Addresses of Organizations page. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

# Addresses of Organizations

British Library Lending Division
Boston Spa, Wetherby, Yorkshire
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, DC 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

European Space Agency–
    Information Retrieval Service ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

ESDU International
27 Corsham Street
London
N1 6UA
England

Fachinformationszentrum Karlsruhe
    Gesellschaft für wissenschaftlich–technische
    Information mbH
76344 Eggenstein–Leopoldshafen, Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

(NASA STI Lead Center)
National Aeronautics and Space Administration
Scientific and Technical Information Program Office
Langley Research Center – MS157
Hampton, VA 23681

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, CA 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, MI 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library National Center
MS 950
12201 Sunrise Valley Drive
Reston, VA 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, AZ 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS914
Denver, CO 80225

# NASA CASI Price Code Table

(Effective July 1, 1996)

| CASI PRICE CODE | NORTH AMERICAN PRICE | FOREIGN PRICE |
|---|---|---|
| A01 | $ 6.50 | $ 13.00 |
| A02 | 10.00 | 20.00 |
| A03 | 19.50 | 39.00 |
| A04-A05 | 21.50 | 43.00 |
| A06 | 25.00 | 50.00 |
| A07 | 28.00 | 56.00 |
| A08 | 31.00 | 62.00 |
| A09 | 35.00 | 70.00 |
| A10 | 38.00 | 76.00 |
| A11 | 41.00 | 82.00 |
| A12 | 44.00 | 88.00 |
| A13 | 47.00 | 94.00 |
| A14-A17 | 49.00 | 98.00 |
| A18-A21 | 57.00 | 114.00 |
| A22-A25 | 67.00 | 134.00 |
| A99 | Call For Price | Call For Price |

## Important Notice

The $1.50 domestic and $9.00 foreign shipping and handling fee currently being charged will remain the same. Foreign airmail is $27.00 for the first 1-3 items, $9.00 for each additional item. Additionally, a new processing fee of $2.00 per each video ordered will be assessed.

For users registered at the NASA CASI, document orders may be invoiced at the end of the month, charged against a deposit account, or paid by check or credit card. NASA CASI accepts American Express, Diners' Club, MasterCard, and VISA credit cards. There are no shipping and handling charges. To register at the NASA CASI, please request a registration form through the NASA STI Help Desk at the numbers or addresses below.

## Return Policy

The NASA Center for AeroSpace Information will gladly replace or make full refund on items you have requested if we have made an error in your order, if the item is defective, or if it was received in damaged condition and you contact us within 30 days of your original request. Just contact our NASA STI Help Desk at the numbers or addresses listed below.

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

E-mail: help@sti.nasa.gov
Fax: (301) 621-0134
Phone: (301) 621-0390

Rev. 3/98

## Federal Depository Library Program

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 53 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 53 regional depositories. A list of the Federal Regional Depository Libraries, arranged alphabetically by state, appears at the very end of this section. These libraries are not sales outlets. A local library can contact a regional depository to help locate specific reports, or direct contact may be made by an individual.

## Public Collection of NASA Documents

An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England for public access. The British Library Lending Division also has available many of the non-NASA publications cited in the STI Database. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents FIZ–Fachinformation Karlsruhe–Bibliographic Service, D-76344 Eggenstein-Leopoldshafen, Germany and TIB–Technische Informationsbibliothek, P.O. Box 60 80, D-30080 Hannover, Germany.

## Submitting Documents

All users of this abstract service are urged to forward reports to be considered for announcement in the STI Database. This will aid NASA in its efforts to provide the fullest possible coverage of all scientific and technical publications that might support aeronautics and space research and development. If you have prepared relevant reports (other than those you will transmit to NASA, DOD, or DOE through the usual contract- or grant-reporting channels), please send them for consideration to:

> ATTN: Acquisitions Specialist
> NASA Center for AeroSpace Information
> 7121 Standard Drive
> Hanover, MD 21076-1320.

Reprints of journal articles, book chapters, and conference papers are also welcome.

You may specify a particular source to be included in a report announcement if you wish; otherwise the report will be placed on a public sale at the NASA Center for AeroSpace Information. Copyrighted publications will be announced but not distributed or sold.

# Federal Regional Depository Libraries

**ALABAMA**
**AUBURN UNIV. AT MONTGOMERY**
 **LIBRARY**
Documents Dept.
7300 University Dr.
Montgomery, AL 36117–3596
(205) 244–3650 Fax: (205) 244–0678

**UNIV. OF ALABAMA**
Amelia Gayle Gorgas Library
Govt. Documents
P.O. Box 870266
Tuscaloosa, AL 35487–0266
(205) 348–6046 Fax: (205) 348–0760

**ARIZONA**
**DEPT. OF LIBRARY, ARCHIVES,**
 **AND PUBLIC RECORDS**
Research Division
Third Floor, State Capitol
1700 West Washington
Phoenix, AZ 85007
(602) 542–3701 Fax: (602) 542–4400

**ARKANSAS**
**ARKANSAS STATE LIBRARY**
State Library Service Section
Documents Service Section
One Capitol Mall
Little Rock, AR 72201–1014
(501) 682–2053 Fax: (501) 682–1529

**CALIFORNIA**
**CALIFORNIA STATE LIBRARY**
Govt. Publications Section
P.O. Box 942837 – 914 Capitol Mall
Sacramento, CA 94337–0091
(916) 654–0069 Fax: (916) 654–0241

**COLORADO**
**UNIV. OF COLORADO – BOULDER**
Libraries – Govt. Publications
Campus Box 184
Boulder, CO 80309–0184
(303) 492–8834 Fax: (303) 492–1881

**DENVER PUBLIC LIBRARY**
Govt. Publications Dept. BSG
1357 Broadway
Denver, CO 80203–2165
(303) 640–8846 Fax: (303) 640–8817

**CONNECTICUT**
**CONNECTICUT STATE LIBRARY**
231 Capitol Avenue
Hartford, CT 06106
(203) 566–4971 Fax: (203) 566–3322

**FLORIDA**
**UNIV. OF FLORIDA LIBRARIES**
Documents Dept.
240 Library West
Gainesville, FL 32611–2048
(904) 392–0366 Fax: (904) 392–7251

**GEORGIA**
**UNIV. OF GEORGIA LIBRARIES**
Govt. Documents Dept.
Jackson Street
Athens, GA 30602–1645
(706) 542–8949 Fax: (706) 542–4144

**HAWAII**
**UNIV. OF HAWAII**
Hamilton Library
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948–8230 Fax: (808) 956–5968

**IDAHO**
**UNIV. OF IDAHO LIBRARY**
Documents Section
Rayburn Street
Moscow, ID 83844–2353
(208) 885–6344 Fax: (208) 885–6817

**ILLINOIS**
**ILLINOIS STATE LIBRARY**
Federal Documents Dept.
300 South Second Street
Springfield, IL 62701–1796
(217) 782–7596 Fax: (217) 782–6437

**INDIANA**
**INDIANA STATE LIBRARY**
Serials/Documents Section
140 North Senate Avenue
Indianapolis, IN 46204–2296
(317) 232–3679 Fax: (317) 232–3728

**IOWA**
**UNIV. OF IOWA LIBRARIES**
Govt. Publications
Washington & Madison Streets
Iowa City, IA 52242–1166
(319) 335–5926 Fax: (319) 335–5900

**KANSAS**
**UNIV. OF KANSAS**
Govt. Documents & Maps Library
6001 Malott Hall
Lawrence, KS 66045–2800
(913) 864–4660 Fax: (913) 864–3855

**KENTUCKY**
**UNIV. OF KENTUCKY**
King Library South
Govt. Publications/Maps Dept.
Patterson Drive
Lexington, KY 40506–0039
(606) 257–3139 Fax: (606) 257–3139

**LOUISIANA**
**LOUISIANA STATE UNIV.**
Middleton Library
Govt. Documents Dept.
Baton Rouge, LA 70803–3312
(504) 388–2570 Fax: (504) 388–6992

**LOUISIANA TECHNICAL UNIV.**
Prescott Memorial Library
Govt. Documents Dept.
Ruston, LA 71272–0046
(318) 257–4962 Fax: (318) 257–2447

**MAINE**
**UNIV. OF MAINE**
Raymond H. Fogler Library
Govt. Documents Dept.
Orono, ME 04469–5729
(207) 581–1673 Fax: (207) 581–1653

**MARYLAND**
**UNIV. OF MARYLAND – COLLEGE PARK**
McKeldin Library
Govt. Documents/Maps Unit
College Park, MD 20742
(301) 405–9165 Fax: (301) 314–9416

**MASSACHUSETTS**
**BOSTON PUBLIC LIBRARY**
Govt. Documents
666 Boylston Street
Boston, MA 02117–0286
(617) 536–5400, ext. 226
Fax: (617) 536–7758

**MICHIGAN**
**DETROIT PUBLIC LIBRARY**
5201 Woodward Avenue
Detroit, MI 48202–4093
(313) 833–1025 Fax: (313) 833–0156

**LIBRARY OF MICHIGAN**
Govt. Documents Unit
P.O. Box 30007
717 West Allegan Street
Lansing, MI 48909
(517) 373–1300 Fax: (517) 373–3381

**MINNESOTA**
**UNIV. OF MINNESOTA**
Govt. Publications
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 624–5073 Fax: (612) 626–9353

**MISSISSIPPI**
**UNIV. OF MISSISSIPPI**
J.D. Williams Library
106 Old Gym Bldg.
University, MS 38677
(601) 232–5857 Fax: (601) 232–7465

**MISSOURI**
**UNIV. OF MISSOURI – COLUMBIA**
106B Ellis Library
Govt. Documents Sect.
Columbia, MO 65201–5149
(314) 882–6733 Fax: (314) 882–8044

**MONTANA**
**UNIV. OF MONTANA**
Mansfield Library
Documents Division
Missoula, MT 59812–1195
(406) 243–6700 Fax: (406) 243–2060

**NEBRASKA**
**UNIV. OF NEBRASKA – LINCOLN**
D.L. Love Memorial Library
Lincoln, NE 68588–0410
(402) 472–2562 Fax: (402) 472–5131

**NEVADA**
**THE UNIV. OF NEVADA**
 **LIBRARIES**
Business and Govt. Information
 Center
Reno, NV 89557–0044
(702) 784–6579 Fax: (702) 784–1751

**NEW JERSEY**
**NEWARK PUBLIC LIBRARY**
Science Div. – Public Access
P.O. Box 630
Five Washington Street
Newark, NJ 07101–7812
(201) 733–7782 Fax: (201) 733–5648

**NEW MEXICO**
**UNIV. OF NEW MEXICO**
General Library
Govt. Information Dept.
Albuquerque, NM 87131–1466
(505) 277–5441 Fax: (505) 277–6019

**NEW MEXICO STATE LIBRARY**
325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827–3824 Fax: (505) 827–3888

**NEW YORK**
**NEW YORK STATE LIBRARY**
Cultural Education Center
Documents/Gift & Exchange Section
Empire State Plaza
Albany, NY 12230–0001
(518) 474–5355 Fax: (518) 474–5786

**NORTH CAROLINA**
**UNIV. OF NORTH CAROLINA –**
 **CHAPEL HILL**
Walter Royal Davis Library
CB 3912, Reference Dept.
Chapel Hill, NC 27514–8890
(919) 962–1151 Fax: (919) 962–4451

**NORTH DAKOTA**
**NORTH DAKOTA STATE UNIV. LIB.**
Documents
P.O. Box 5599
Fargo, ND 58105–5599
(701) 237–8886 Fax: (701) 237–7138

**UNIV. OF NORTH DAKOTA**
Chester Fritz Library
University Station
P.O. Box 9000 – Centennial and
 University Avenue
Grand Forks, ND 58202–9000
(701) 777–4632 Fax: (701) 777–3319

**OHIO**
**STATE LIBRARY OF OHIO**
Documents Dept.
65 South Front Street
Columbus, OH 43215–4163
(614) 644–7051 Fax: (614) 752–9178

**OKLAHOMA**
**OKLAHOMA DEPT. OF LIBRARIES**
U.S. Govt. Information Division
200 Northeast 18th Street
Oklahoma City, OK 73105–3298
(405) 521–2502, ext. 253
Fax: (405) 525–7804

**OKLAHOMA STATE UNIV.**
Edmon Low Library
Stillwater, OK 74078–0375
(405) 744–6546 Fax: (405) 744–5183

**OREGON**
**PORTLAND STATE UNIV.**
Branford P. Millar Library
934 Southwest Harrison
Portland, OR 97207–1151
(503) 725–4123 Fax: (503) 725–4524

**PENNSYLVANIA**
**STATE LIBRARY OF PENN.**
Govt. Publications Section
116 Walnut & Commonwealth Ave.
Harrisburg, PA 17105–1601
(717) 787–3752 Fax: (717) 783–2070

**SOUTH CAROLINA**
**CLEMSON UNIV.**
Robert Muldrow Cooper Library
Public Documents Unit
P.O. Box 343001
Clemson, SC 29634–3001
(803) 656–5174 Fax: (803) 656–3025

**UNIV. OF SOUTH CAROLINA**
Thomas Cooper Library
Green and Sumter Streets
Columbia, SC 29208
(803) 777–4841 Fax: (803) 777–9503

**TENNESSEE**
**UNIV. OF MEMPHIS LIBRARIES**
Govt. Publications Dept.
Memphis, TN 38152–0001
(901) 678–2206 Fax: (901) 678–2511

**TEXAS**
**TEXAS STATE LIBRARY**
United States Documents
P.O. Box 12927 – 1201 Brazos
Austin, TX 78701–0001
(512) 463–5455 Fax: (512) 463–5436

**TEXAS TECH. UNIV. LIBRARIES**
Documents Dept.
Lubbock, TX 79409–0002
(806) 742–2282 Fax: (806) 742–1920

**UTAH**
**UTAH STATE UNIV.**
Merrill Library Documents Dept.
Logan, UT 84322–3000
(801) 797–2678 Fax: (801) 797–2677

**VIRGINIA**
**UNIV. OF VIRGINIA**
Alderman Library
Govt. Documents
University Ave. & McCormick Rd.
Charlottesville, VA 22903–2498
(804) 824–3133 Fax: (804) 924–4337

**WASHINGTON**
**WASHINGTON STATE LIBRARY**
Govt. Publications
P.O. Box 42478
16th and Water Streets
Olympia, WA 98504–2478
(206) 753–4027 Fax: (206) 586–7575

**WEST VIRGINIA**
**WEST VIRGINIA UNIV. LIBRARY**
Govt. Documents Section
P.O. Box 6069 – 1549 University Ave.
Morgantown, WV 26506–6069
(304) 293–3051 Fax: (304) 293–6638

**WISCONSIN**
**ST. HIST. SOC. OF WISCONSIN**
 **LIBRARY**
Govt. Publication Section
816 State Street
Madison, WI 53706
(608) 264–6525 Fax: (608) 264–6520

**MILWAUKEE PUBLIC LIBRARY**
Documents Division
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 286–3073 Fax: (414) 286–8074

# Typical Report Citation and Abstract

❶ 19970001126  NASA Langley Research Center, Hampton, VA USA

❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**

❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;

❹ Mar. 1996; 130p; In English

❺ Contract(s)/Grant(s): RTOP 505-68-70-04

❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

❼     To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10' to 50', and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65' swept forebody serrations tended to roll together, while vortices from 40' swept serrations were more effective in generating additional lift caused by their more independent nature.

❽ Author

❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

## Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
7. Abstract
8. Abstract Author
9. Subject Terms

## 01
## AERONAUTICS

**19980026096**

**Buying and owning your own airplane (2nd edition)**

Ellis, James E., Analytical Systems Engineering Corp., USA; 1991; In English; ISBN 0-8138-0170; Copyright; Avail: Aeroplus Dispatch

The book contains all the information necessary for buying and owning an airplane, from selecting partners and home fields to negotiating sales contracts to maintaining and upgrading the airplane. A survey of all the types of planes, new and used, that can be expected to be found for sale is presented. In this new edition, every chapter has been updated to include such information as the new requirements for obtaining and retaining insurance coverage, the effect of tax law changes and leasebacks, and how the general aviation industry was changed in the 1980s.

AIAA

*Aircraft Maintenance; General Aviation Aircraft; Airports; Insurance (Contracts)*


**19980027944**

**The student pilot's flight manual (6th edition)**

Kershner, William K., USA; 1990; In English; ISBN 0-8138-1611-4; Copyright; Avail: Aeroplus Dispatch

The manual contains material used in preflight and postflight briefings and in-flight instruction. It includes information for use in the day-to-day process of learning to fly airplanes. Emphasis is placed on making decisions in various areas of flying to help the student pilot to start setting up individual methods of coming to the right decision for a go or no-go situation. The material is organized under the following headings: before the flight, presolo, postsolo maneuvers, cross-country and night flying, and the written and practical flight tests. Also included are Federal Aviation regulations and National Transportation Safety Board requirements.

AIAA

*Manuals; Pilot Training; Night Flights (Aircraft); Emergencies*


**19980028571**

**Aeroelastic stability analysis of infilling members of transmission towers** *Aeroelastische Stabilitaetsuntersuchung der Ausfachungsstaebe von Hochspannungsmasten*

Fink, Josef; Stahlbau; September, 1997; ISSN 0038-9145; Volume 66, no. 9, pp. 663-669; In German; Copyright; Avail: Issuing Activity

The problem of aeroelastic stability is to find out the so named critical wind rates by which a body gets into vibrations caused by itself. The aircraft forces in a universally valid form are derived from stationary dimensionless worthies of aircraft forces. The critical wind rates of the crossing member are worked out by a finite element program. Qualitative statements are derived from this calculation results. This paper was carried out by the author as a dissertation at the Institute for Steel Construction at the Technical University Vienna under direction of o. Univ. Prof. Dipl. Ing. Dr. Gunter Ramberger.

EI

*Aerodynamic Stability; Stability Tests; Towers; Aerodynamics; Shear Stress; Wind Shear; Vibration Mode; Finite Element Method*

**19980029745**

**Explicit multi-time-stepping algorithm for aerodynamic flows**

van der Ven, H., Natl. Aerospace Lab. NLR, Netherlands; Niemann-Tuitman, B. E.; Veldman, A. E. P.; Journal of Computational and Applied Mathematics; September 15, 1997; ISSN 0377-0427; Volume 82, no. 1-2, pp. 423-431; In English; Copyright; Avail: Issuing Activity

An explicit multi-time-stepping algorithm with applications to aerodynamic flows is presented. In the algorithm, in different parts of the computational domain different time steps are taken, and the flow is synchronized at the so-called synchronization levels. The algorithm is validated for aerodynamic turbulent flows. For two-dimensional flows speedups in the order of five with respect to single time stepping are obtained

Author (EI)

*Computational Fluid Dynamics; Aerodynamics; Algorithms; Turbulent Flow*


**19980030360**

**Two-look method for correction of roll errors in aircraft-borne interferometric SAR**

Bullock, R. J.; Voles, R.; Currie, A.; Griffiths, H. D.; Brennan, P. V.; Electronics Letters; August 28, 1997; ISSN 0013-5194; Volume 33, no. 18, pp. 1581-1583; In English; Copyright; Avail: Issuing Activity

A technique is described for compensating for aircraft roll in dual antenna interferometric SAR from an airborne platform. The technique does not rely on prior knowledge of the target scene, or input from an inertial navigation unit (INU). The technique is tested on real data from the DRA's C-band interferometric SAR, which is fitted to an Andover aircraft, and the results are compared with output from a Litton-93 medium accuracy INU.

Author (EI)

*Error Analysis; Inertial Navigation; Synthetic Aperture Radar; Aircraft Communication; Interferometry*


**19980030365**

**Dynamic analysis of mechanical systems and structures with large parameter variations**

Whalley, R., Univ. of Bradford, UK; Ebrahimi, M.; Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering; 1997; ISSN 0954-4100; Volume 211, no. 3, pp. 169-181; In English; Copyright; Avail: Issuing Activity

A general approach to the analysis of mechanical systems and structures where large parameter variations occur is outlined. Aircraft and missile problems where there are acknowledged changes in the system model coefficients are identified. Performance variations associated with operational conditions are investigated. Simple solutions to the determinantal equation are proposed.

Author (EI)

*Missiles; Mathematical Models; Matrix Theory*


**19980033517**  Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine,  France

**Future Aerospace Technology in the Service of the Alliance, Volume 1, Affordable Combat Aircraft and Plenary Sessions**
*Les Technologies Aeronautiques et Spatiales du Futur au Service de L'Alliance Atlantique, Volume 1, Le Cout de Possession des Avions de Combat*

Future Aerospace Technology in the Service of the Alliance; Dec. 1997; 310p; In French; In English; Future Aerospace Technology in the Service of the Alliance, 14-17 Apr. 1997, Palaiseau, France; Also announced as 19980033518 through 19980033540
Report No.(s): AGARD-CP-600-Vol-1; ISBN 92-836-0047-9; Copyright Waived; Avail: CASI; A14, Hardcopy; A03, Microfiche

One of three volumes containing the unclassified papers presented at a conference on "Future Aerospace Technology in the Service of the Alliance" organised by AGARD (NATO's Advisory Group for Aerospace Research and Development) at Palaiseau, near Paris, France, 14-17 April 1997. The conference took the form of three parallel symposia and three plenary sessions. This volume contains the papers from the three plenary sessions: Future Directions in Aerospace Systems Future NATO Trends and Mission Scenarios Human Machine Interaction in the Future and the symposium on "Affordable Combat Aircraft", which had sessions on: Affordability of Procurement, Combat Effectiveness, Affordability of Ownership, The Human Element. Volume 2 contains the papers on "Mission Systems Technologies". Volume 3 contains the papers on "Sustained Hypersonic Flight".

Author

*Fighter Aircraft; North Atlantic Treaty Organization (NATO); Combat; Hypersonic Flight; Aerospace Systems*


**19980033535**  Dassault Aviation, Saint-Cloud,  France

**Reducing Maintenance Costs for Combat Aircraft Air Frames**  *La Reduction des Couts de Maintenance des Cellules D'Avions de Combat*

Chaumette, Daniel, Dassault Aviation, France; Armando, Patrick, Delegation Generale de l'Armement, France; Future Aerospace

Technology in the Service of the Alliance; Dec. 1997; Volume 1; 12p; Summary translated by Schreiber; In French; Also announced as 19980033517; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Maintaining a fleet of combat aircraft ready for operational employment for a group of missions with a fixed availability rate according to all evidence requires that all aircraft, during their service life, be subject to maintenance and inspection, or to repair or replacement; all of these activities are essential for flight safety. Different maintenance situations arise as a function of the critical nature and reliability of the systems involved, the scope of operations and their periodicity, as well as the required resources and skills. In this case, maintenance will be of the programmed type, i.e., of the planned type, and/or it will be unprogrammed and will focus on the air frame, the engine, the systems, and the equipment.
Derived from text
*Aircraft Maintenance; Cost Reduction; Service Life; Reliability; Fighter Aircraft; Airframes*


**19980033685**
### Numerical model for thin airfoils in unsteady motion
de Oliveira Soviero, Paulo Afonso, ITA - Instituto Tecnologico de Aeronautica, Brazil; Lavagna, Luis G. M.; Revista Brasileira de Ciencias Mecanicas/Journal of the Brazilian Society of Mechanical Sciences; September, 1997; ISSN 0100-7386; Volume 19, no. 3, pp. 332-340; In English; Copyright; Avail: Issuing Activity

A numerical model based on normal dipole panels with constant strength distributions is proposed in order to solve the linearized unsteady motion of the thin airfoil in incompressible inviscid flow. The direct relationship between vortices and normal dipole panels with constant strength distributions is employed, with the specific aim of simplifying the numerical implementation of circulation conservation, force calculation and vortex shedding. The suggested method is fast and general. Classical unsteady thin airfoil problems are solved by the present model and the results are shown to compare well with analytical results.
Author (EI)
*Incompressible Flow; Mathematical Models; Thin Airfoils; Airfoils; Unsteady Flow; Vortices; Vortex Shedding*


**19980034480**
### Numerical inviscid vortex model applied to parallel blade-vortex interaction
Fonseca, Gustavo Farias, Universidade Federal do Rio de Janeiro, Brazil; Bodstein, Gustavo Cesar Rachid; Hirata, Miguel Hiroo; Revista Brasileira de Ciencias Mecanicas/Journal of the Brazilian Society of Mechanical Sciences; September, 1997; ISSN 0100-7386; Volume 19, no. 3, pp. 341-356; In English; Copyright; Avail: Issuing Activity

In this paper a numerical inviscid vortex method is applied to the unsteady, two-dimensional and incompressible flow that occurs during a parallel blade-vortex interaction. We use a vorticity-panel method, where the airfoil bound vorticity is modeled as a discrete distribution of vortices having strength continuously and linearly distributed over the airfoil surface. The impermeability condition is satisfied on the airfoil surface, whereas the no-slip condition is not. The generation of the wake vorticity is accomplished with the equation of conservation of circulation and the application of the Kutta condition, which imposes the continuity of the pressure field at the airfoil trailing edge. The vortices shed into the flow to form the airfoil wake are convected downstream with the mean flow using a Lagrangian time-marching scheme. The main vortex that interacts with the airfoil is modeled as a potential vortex. The numerical results are compared to the experimental data of Straus et al. (1990), showing good agreement for the entire flow, except when the vortex is close enough to the trailing edge so that separation occurs.
Author (EI)
*Blade-Vortex Interaction; Incompressible Flow; Inviscid Flow; Mathematical Models; Two Dimensional Flow; Unsteady Flow; Aerodynamics; Vortices; Hydrodynamics*


**19980034481**
### Convergence acceleration applied to compressible and incompressible fluid flow calculations
De Bortoli, Alvaro Luiz, Federal Univ. of Rio Grande de Sul, Brazil; Revista Brasileira de Ciencias Mecanicas/Journal of the Brazilian Society of Mechanical Sciences; September, 1997; ISSN 0100-7386; Volume 19, no. 3, pp. 357-370; In English; Copyright; Avail: Issuing Activity

Today, numerical flow simulation plays more and more important role in the design process of an aerodynamic body. to design a new mechanical device involving fluid dynamics, a numerical simulation is well accepted and justified. However, much work still remains to improve the numerical methods towards a fast, accurate and stable convergence. Techniques to accelerate the convergence, namely the local time-stepping, residual averaging and multigrid techniques are normally employed. This work employs acceleration techniques to solve compressible and incompressible fluid flows using a finite volume, explicit Runge-Kutta multistage scheme with central spatial discretization in combination with multigrid and preconditioning. Numerical results are

presented for a three-dimensional channel and the NACA 00012 airfoil for Mach-numbers ranging from 0.8 to 0.005 using the Euler equations.

Author (EI)

*Compressible Fluids; Fluid Flow; Incompressible Flow; Incompressible Fluids; Runge-Kutta Method; Computational Fluid Dynamics; Computerized Simulation; Aerodynamics; Compressible Flow; Finite Volume Method*


**19980034572**

**Air loads on a rigid plate oscillating normal to a fixed surface**

Beltman, W. M., Univ. of Twente, Netherlands; Van Der Hoogt, P. J. M.; Spiering, R. M. E. J.; Tijdeman, H.; Journal of Sound and Vibration; September 18, 1997; ISSN 0022-460X; Volume 206, no. 2, pp. 217-241; In English; Copyright; Avail: Issuing Activity

This paper deals with a theoretical and experimental investigation on a rigid, rectangular plate oscillating in the proximity of a fixed surface. The plate is suspended by springs. The airloads generated by the oscillating motion of the plate are determined. Due to the fact that the plate is rigid, the system is modelled as a 1-DOF system. The influence of the surrounding air is detected by changes in the plate's natural frequency and damping. For the behavior of the air in the gap between the plate and the fixed surface an analytical solution is presented. This solution includes the effects of inertia, viscosity, compressibility and thermal conductivity. It is shown that the main parameters governing the motion of the air in the gap are the shear wave number, the reduced frequency, the narrowness of the gap and the aspect ratio of the plate. With these parameters the validity of several simplifications can easily be demonstrated and solutions, given in the literature, can be put in perspective. Special experiments were carried out with an oscillating solar panel in order to verify the analytical model. The analytical results and the experimental results show fair agreement. The solutions shows that for low shear wave numbers the effects of viscosity cannot be discarded.

Author (EI)

*Aerodynamic Loads; Compressibility Effects; Plates (Structural Members); Air; Oscillations; Damping*


**19980035004**  Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine,  France

**Advances in Flight Testing**  *Les Avancees Dans le Domaine des essais en vol*

Dec. 1997; 400p; In French; Flight Vehicle Integration Panel Symposium, 23-26 Sep. 1996, Lisbon, Portugal; Also announced as 19980035005 through 19980035034

Report No.(s): AGARD-CP-593; ISBN 92-836-0050-9; Copyright Waived; Avail: CASI; A17, Hardcopy; A04, Microfiche

The Symposium comprised six sessions, each being devoted to a particular field, with one session on Systems Evaluation, including avionics, navigation, propulsion and weapons aspects, two sessions on Technological Advances covering all technical fields such as avionics software, simulation, instrumentation, aerodynamics, test methods etc., one session devoted to an Overview of Current Programmes, one session on Flight Dynamics, incorporating handling qualities, performance and flight controls, and one session addressing Management Problems in Testing. The symposium closed with a discussion between government representatives and manufacturers on "The role of governments in development testing in the 21st century".

Author

*Conferences; Computerized Simulation; Aerodynamics; Avionics*


**19980035005**  Flight Test Squadron (418), DOEAC, Edwards AFB, CA USA

**C-17A Avionics Flight Test Program**

MacLean, William J., Flight Test Squadron (418), USA; Dublenko, A. Lawrence, Aerospace Engineering Test Establishment, Canada; Advances in Flight Testing; Dec. 1997; 16p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

To date, the C-17A is one of the most advanced military airlift aircraft in the world. The corresponding avionics have reduced the number of crew members in the cockpit from four to two, and at the same time have increased the pilot's awareness of his aircraft's capabilities. The DT&E avionics program introduced many challenges to efficiently and adequately test the system to a high level of confidence before releasing the capability to the user. The use of effective test team structure helped to make the test program as efficient as possible, and the many lessons learned were incorporated into the program as testing progressed. As complex as the C-17A avionics suite is, it is a highly capable system with room for growth to increase future capability. In December 1979, the USA Department of Defense launched the Cargo-Experimental (CX) program to define the capabilities needed in a new strategic airlift aircraft. The result was the C-17A Globemaster III which incorporates supercritical airfoil technology and winglets for long-range cruise performance as well as large externally blown flaps, full-span leading edge slats, spoilers, high sink-rate landing gear, anti-skid braking, and thrust reversers for rapid tactical descent and enhanced performance at short airfields. Further, the advanced C-17A integrated avionics suite, which consists of more than 60 remote terminals on nine different

MIL-STD1553 busses, enables an aircrew of only two pilots and one loadmaster to carry out the C-17A long range heavy airlift mission. Test mission planning, test conduct, and analysis used both traditional and new test techniques to successfully accomplish the test mission. Lessons learned have been mostly m the realm of test planning and preparation. The sheer number of test points for the entire program (8000 total) and the manner in which testing was divided into aircraft systems contributed to inefficiencies in test flights. The C-17A avionics flight test program introduced many challenges to efficiently and adequately test a complex integrated avionics system to a high level of confidence before releasing capability to the user. The use of an effective test team structure and test planning helped to make the test program as efficient as possible, with many lessons learned being incorporated into the program as testing progressed. As complex as the C-17A avionics suite is, it is a highly capable system with room for growth to increase future capability.

Author

*Flight Tests; Test Facilities; Mission Planning; Leading Edge Slats; Landing Gear; Flight Crews; Antiskid Devices; Airfoils*

## 19980036747

### Control freaks to speed freaks

Gregory, Annie; Manufacturing Computer Solutions; October, 1997; ISSN 1358-1066; Volume 3, no. 9, pp. 53, 55; In English; Copyright; Avail: Issuing Activity

The aerospace industry relies increasingly on advances in manufacturing planning and control software to meet its trading challenges. It is also becoming an increasingly heavy user of new networking technology to meet its other major challenge: the need to inject speed and flexibility into the way it distributes and shares the vast amount of data that underpin all its projects. Speed, control, compliance, cooperation are the watchwords of aerospace manufacturing. The supporting information technology (IT) is keeping pace with the commercial need but the costs and strain of change are severe at all levels of the supply chain. It is likely that only the agile are facing the future with confidence.

EI

*Computer Networks; Computer Aided Manufacturing; Computer Aided Design; Aerospace Engineering; Local Area Networks*

## 02
## AERODYNAMICS

*Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.*

## 19980024559

### Simulation studies of parafoil opening dynamics

Li, Guoguang, National Univ. of Defense Technology, China; Deng, Zhencai, National Univ. of Defense Technology, China; 1991, pp. 98-101; In English; Copyright; Avail: Aeroplus Dispatch

A 1D opening model of a parafoil is presented. The canopy inflation and motion equations for calculating the filling time of the parafoil opening problem are presented.

AIAA

*Recovery Parachutes; Equations of Motion; Time Response; Data Simulation*

## 19980024954

### Application of an orthogonal algorithm to the estimation of aerodynamic coefficients of elastic aircraft

Cui, Pingyuan, Harbin Inst. of Technology, China; Wu, Yaohua, Harbin Inst. of Technology, China; Yang, Di, Harbin Inst. of Technology, China; 1991, pp. 68-73; In English; Copyright; Avail: Aeroplus Dispatch

A new identification method for estimating aerodynamic coefficients in aircraft is proposed based on the maximum likelihood method. The algorithm is used to obtain the inverse of the initial matrix in the modified Newton-Raphson scheme with estimated sensitivities (MNRES). Results using this orthogonal MNRES method are presented.

AIAA

*Aircraft Structures; Aerodynamic Coefficients; Orthogonal Functions; System Identification; Maximum Likelihood Estimates*

## 19980024968

### Numerical simulation of rarefied gas flow over axisymmetric blunt bodies

Shen, Huili, Northwestern Polytechnical Univ., China; Jji, Minggang, Northwestern Polytechnical Univ., China; Zhu, Yipu, Northwestern Polytechnical Univ., China; Zhen, Xiapqing, Northwestern Polytechnical Univ., China; 1991, pp. 133-140; In English; Copyright; Avail: Aeroplus Dispatch

An alternative numerical approach is presented for simulating the transitional flow of rarefied gas over axisymmetric blunt bodies in the 80-140 km altitude range in which the transition of the flow around the Space Shuttle from free molecular to continuum behavior takes place. Based on a two-beam model, a single set of aerodynamic equations is developed which describe the mean flow properties. Boundary conditions are formulated and calculative examples are given using a sweep FEM which provides good convergence and calculative stability.

AIAA

*Rarefied Gas Dynamics; Blunt Bodies; Digital Simulation; Axisymmetric Bodies*


**19980026438**

**Production of shear flow profiles in a wind tunnel by a shaped honeycomb technique**

Ahmed, F., Univ. of Bahrain, Bahrain; Lee, B. E.; Journal of Fluids Engineering, Transactions of the ASME; September, 1997; ISSN 0098-2202; Volume 119, no. 3, pp. 713-715; In English; Copyright; Avail: Issuing Activity

The method of shaped honeycomb technique to produce linear shear flows is described. This method is useful to obtain the most reasonable and accurate results. The most important and significant implication of this method is that linear shear flows with very low turbulence levels downstream of the honeycomb can be produced.

EI

*Honeycomb Structures; Shear Flow; Wind Tunnels; Turbulence; Velocity; Computerized Simulation*


**19980030782**  NASA Langley Research Center, Hampton, VA USA

**Mars Pathfider Rarefied Aerodynamics: Computations and Measurements**

Moss, James N., NASA Langley Research Center, USA; Blanchard, Robert C., NASA Langley Research Center, USA; Wilmoth, Richard G., NASA Langley Research Center, USA; Braun,  Robert D., NASA Langley Research Center, USA; 1998; 20p; In English; 36th; Aerospace Science Meeting and Exhibit, 12-15 Jan. 1998, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA/TM-1998-207312; NAS 1.15:207312; AIAA Paper 98-0298; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

On July 4, 1997, after traveling close to 500 million km, the Pathfinder spacecraft successfully completed entry, descent, and landing at Mars. In the present paper, the focus is on the hypersonic rarefied portion of Pathfinder's atmospheric entry where the synergy of flight measurements, aerodynamic calculations, and atmospheric modeling tools are used to extract Pathfinder's attitude and the freestream density. Accuracy of the capsule aerodynamics directly impacts the inferred atmospheric properties extracted from deceleration measurements made by on-board accelerometers. The range of rarefaction considered in this study extends from the free molecular to continuum conditions and angles of attack from O to 30 deg. The aerodynamic computations are made with free-molecular and direct simulation Monte Carlo codes. The calculations show that Pathfinder is statically unstable for much of the transitional rarefied regime. Due to the relatively modest forces and the gyroscopic motion of the spacecraft, the angle of attack excursions were less than 5 deg as inferred from force measurements for the rarefied portion of entry and approached a nominal zero degree trim angle near hypersonic continuum conditions.

Author

*Mars Landing; Measuring Instruments; Spacecraft Motion; Meteorological Parameters; Computerized Simulation; Atmospheric Chemistry*


**19980032586**  NASA Ames Research Center, Moffett Field, CA USA

**Reduction of Helicopter Blade-Vortex Interaction Noise by Active Rotor Control Technology**

Yu, Yung H., NASA Ames Research Center, USA; Gmelin, Bernd, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Splettstoesser, Wolf, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Brooks, Thomas F., NASA Langley Research Center, USA; Philippe, Jean J., Office National d'Etudes et de Recherches Aerospatiales, France; Prieur, Jean, Office National d'Etudes et de Recherches Aerospatiales, France; Progress in Aerospace Sciences; 1997; ISSN 0376-0421; Volume 33, pp. 647-687; In English

Report No.(s): NASA/TM-97-207568; NAS 1.15:207568; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Helicopter blade-vortex interaction noise is one of the most severe noise sources and is very important both in community annoyance and military detection. Research over the decades has substantially improved basic physical understanding of the mechanisms generating rotor blade-vortex interaction noise and also of controlling techniques, particularly using active rotor control technology. This paper reviews active rotor control techniques currently available for rotor blade vortex interaction noise reduction, including higher harmonic pitch control, individual blade control, and on-blade control technologies. Basic physical mechanisms of each active control technique are reviewed in terms of noise reduction mechanism and controlling aerodynamic

or structural parameters of a blade. Active rotor control techniques using smart structures/materials are discussed, including distributed smart actuators to induce local torsional or flapping deformations, Published by Elsevier Science Ltd.
Author
*Active Control; Blade-Vortex Interaction; Control Systems Design; Smart Structures; Structural Design; Helicopters; Aircraft Noise; Harmonic Control*


**19980035021** Wright Lab., FFI, Wright-Patterson AFB, OH USA
**Forebody vortex control**
Walchli, Lawrence A., Wright Lab., USA; Moorhouse, David J., Wright Lab., USA; Advances in Flight Testing; Dec. 1997; 18p;
In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Much attention has been focussed in recent years on tactical maneuvering in post-stall flight. Such programs as the X31, VISTA/MATV, and the X-29A have established that tactical supermaneuverability at very high Angles of Attack (AOA) is a potent offensive weapon provided that the adversary can be enticed into close-in combat. Never before have requirements for integrating the pilot and aircraft been so important. The aircraft must have robust control authority in all axes, plenty of excess thrust, and pilot-friendly controls which allow him to fly to the limits of both his and the aircraft capability. Modern fighter aircraft operating above about 25 deg. AOA encounter a destabilizing phenomena caused by the complex three-dimensional separated vortical flowfield surrounding it. It is in this same region of flight that the aircraft wings and fuselage begin blanking the rudder, resulting in both degraded directional stability and control authority. Hence, two requirements emerge; increase directional stability and increase directional control authority. Thrust vectoring has been demonstrated as a means to increase control authority at all angles of attack. A potential way to increase directional stability could be by controlling the forebody vortex flow. The primary object of this paper is to document an attempt to increase the directional stability of an F16 aircraft at all angles of attack into the post-stall regime. A wind tunnel test program had previously shown beneficial effects of forebody chines; additional testing provided stability and control data to support a flight test program. Flight tests were conducted with and without chines as a small adjunct to a program investigating thrust vectoring to very high angles of attack, the F-16 VISTA/MATV program. Specific maneuvers up to C(sub Lmax) (and beyond) were assessed to determine the major effects of forebody chines, although parameter identification was not an objective of the program. This paper describes the results of this effort.
Author
*Vortices; Maneuvers; Angle of Attack; Fighter Aircraft; Forebodies; Parameter Identification*


## 03
## AIR TRANSPORTATION AND SAFETY

*Includes passenger and cargo air transport operations; and aircraft accidents.*


**19980024029** NERAC, Inc., Tolland, CT USA
**Parachutes. (Latest citations from the US Patent Bibliographic File with Exemplary Claims)**
Jan. 1998; In English; Page count unavailable.
Report No.(s): PB98-851850; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The bibliography contains citations of selected patents concerning design, fabrication, and testing of parachutes and decelerating devices that use aerodynamic drag. Designs for the canopy, shrouds, and hardware, and operating components, including canopy opening, actuators, staging, reefing, maneuvering, and separation and release mechanisms, are reviewed. Applications include deployment from aircraft for escape or air drop missions, aerial delivery of equipment and munitions, and recovery of drones. (Contains 50-250 citations and includes a subject term index and title list.)
NTIS
*Parachutes; Bibliographies; Design; Fabrication; Performance Tests*


**19980024241** General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
**Aviation Safety: Efforts to Implement Flight Operational Quality Assurance Programs. Report to Congressional Requesters**
Dec. 1997; 41p; In English
Report No.(s): AD-A334086; GAO/RCED-98-10; B-275990; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The analysis of aircraft data recorded during flight has played a crucial role in determining the causes of crashes. Recently, however, some U.S. airlines have begun to analyze flight data from uneventful airline flights to identify potential problems and

correct them before they lead to accidents. GAO was asked examine efforts by the Federal Aviation Administration (FAA) and U.S. airlines to implement Flight Operational Quality Assurance (FOQA) programs. The objective of a FOQA program is to use flight data to detect technical flaws, unsafe practices, or conditions outside of desired operating procedures early enough to allow timely intervention to avert accidents or incidents. These programs are voluntary efforts by airlines that involve equiping aircraft with specialized devices to continuously record up to hundreds of different flight data parameters from aircraft systems and sensors, analyzing the data, identifying trends, and taking action to correct potential problems. The analysis of flight data allows airlines to reconstruct entire flights on the basis of the values over time of flight data parameters, such as heading, altitude, throttle settings, ground speed, and many others. Currently, about 33 foreign airlines and 4 U.S. airlines - United, U.S. Airways, Continental, and Alaska - have implemented FOQA or FOQA-type programs. You requested that we determine (1) how FOQA programs will enhance aviation safety, (2) the costs and benefits of such programs, and (3) the factors that could impede their full implementation and actions that could be taken to overcome any impediments.

DTIC

*Aircraft Safety; Airline Operations; Commercial Aircraft; Flight Safety; Quality Control*


**19980024904**

**Future high speed air transportation system: Recommendations**

1991; In English; Copyright; Avail: Aeroplus Dispatch

An account is given of the discussions and determinations conducted in a symposium held in November 1989 concerning the character of an early 21st-century SST commercial aircraft. It was projected that there will be a market large enough to justify the manufacture of a 250-passenger, 6500 n. mi. SST, with a cruise speed of no more than Mach 2.2. The readiness of the European aerospace establishment for the development and manufacturing task is assessed.

AIAA

*Hypersonic Aircraft; Transport Aircraft; Environment Pollution; Safety Management; Air Traffic Control*


**19980024922**

**Making perfect takeoffs in light airplanes**

Fowler, Ron, Valencia Community College, USA; 1991; In English; ISBN 0-8138-0949-5; Copyright; Avail: Aeroplus Dispatch

The proper procedures to be used by pilots of light aircraft during takeoffs are examined. The forces involved and the dangers to avoid are addressed. Various kinds of takeoffs are considered, including normal takeoffs, short-field takeoffs, soft-field takeoffs, critical takeoff situations, night takeoffs, tailwheel takeoffs. Cardinal rules for perfect takeoffs are given.

AIAA

*Light Aircraft; Takeoff; Airfield Surface Movements*


**19980026915**

**Fly the wing (2nd revised and enlarged edition)**

Webb, Jim, USA; 1990; In English; ISBN 0-8138-0541-4; Copyright; Avail: Aeroplus Dispatch

The new edition incorporates changes that have taken place in the industry since 1971. There have been significant changes in ground school, flight training, and check and rating rides. New chapters have been added on flying in thunderstorms and low-level wind shear. The book covers a wide range of topics, including ground school and study habits, basic and high-speed aerodynamics, approach speed control and target landing, takeoffs, climb, cruise, descent, steep turn, and stalls. Attention is also given to maneuvers at minimum speed, missed approaches and rejected landings, radio failure, flight planning, icing, and winter operation.

AIAA

*Pilot Training; Pilot Selection*


**19980027943**

**The instrument flight manual: The instrument rating (4th revised and enlarged edition)**

Kershner, William K., USA; 1990; In English; Copyright; Avail: Aeroplus Dispatch

The present edition updates the information on the ATC system and procedures and covers the more recent improvements in aircraft instrumentation and avionics. The book covers airplane performance and basic instrument flying, navigation and communications, planning the instrument flight, and the instrument flight. These chapters have been expanded with more partial-panel recoveries and added information on spin recoveries under the hood (or in actual weather).

AIAA

*Manuals; Aircraft Performance; Flight Instruments; Navigation Aids; Air Traffic Control*

**Airline scheduling for the temporary closure of airports**

Yan, Shangyao, Natl. Central Univ., Taiwan, Province of China; Lin, Chung-Gee; Transportation Science; February, 1997; ISSN 0041-1655; Volume 31, no. 1, pp. 72-82; In English; Copyright; Avail: Issuing Activity

The poor scheduling of flights or a fleet resulting from temporary closure of airports may cause substantial loss of profit and decreased levels of service for airline carriers. This research develops a framework in order to help carriers handle schedule perturbations resulting from the temporary closure of airports. The framework is based on a basic model constructed as a time-space network from which several strategic network models are developed for scheduling. These network models are formulated as pure network flow problems or network flow problems with side constraints. The former are solved using the network simplex method whereas the latter are solved using a Lagrangian relaxation-based algorithm. to test how well the model may be applied in the real world, a case study regarding the international operations of a major Taiwan airline was performed. The results show that the framework could be useful in actual operations.
Author (EI)
*Airline Operations; Lagrangian Function; Air Transportation; Perturbation; Mathematical Models; Algorithms; Air Traffic Control*

**Lockerbie investigation: Understanding of the effects of the detonation of 'improvised explosive devices' on aircraft pressure cabins**

Smart, K. P. R., Air Accidents Investigation Branch, UK; Process Safety and Environmental Protection: Transactions of the Institution of Chemical Engineers, Part B; August, 1997; ISSN 0957-5820; Volume 75, no. 3, pp. 138-144; In English; Copyright; Avail: Issuing Activity

The technical investigations conducted by Air Accidents Investigation Branch (AAIB) in the aftermath of the Lockerbie accident are discussed. The investigation focused on the mechanisms that led to the structural failure of Boeing 747 in flight and resulted in the development of safety recommendations for future enhanced aircraft protection from improvised explosive devices. The developments centered on the effects of detonating an explosive device within an aircraft fuselage and methods of mitigating the explosives.
EI
*Aircraft Accidents; Aircraft Compartments; Explosive Devices; Pressurized Cabins; Explosives; Detonation; Accident Prevention; Fuselages*

General Accounting Office, National Security and International Affairs Div., Washington, DC USA

**Briefing Report to the Honorable Ike Skelton, Ranking Minority Member, Committee on National Security, House of Representatives. Military Aircraft Safety: Serious Accidents Remain at Historically Low Levels**

Mar. 1998; 14p; In English
Report No.(s): B-279205; GAO/NSIAD-98-95BR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flight mishaps involve any reportable damage to an aircraft that is preparing to fly, in flight, or completing a landing. Flight mishaps are classified by DOD according to the severity of resulting injury or property damage. Class A mishaps involve damage of $1 million or more, a destroyed aircraft, or a fatality or permanent total disability. The remaining classes of mishaps are distinguished primarily by their loss value and severity of injury: Class B accidents involve damage ranging from $200,000 to less than $1 million, permanent partial disability, or inpatient hospitalization of five or more people; Class C accidents involve damage ranging from $10,000 to less than $200,000 or a lost-time injury; and Class D accidents involve damage of less than $10,000. Our review focused on Class A flight mishaps only. DOD requires that all mishaps be investigated so that causes can be identified and corrective actions taken to prevent future occurrences. Service safety centers play a key role in maintaining aviation mishap statistics, establishing safety policies, disseminating safety information, reviewing mishap investigation reports.
Author
*Aircraft Safety; Congressional Reports; Information Dissemination; Flight Safety*

NASA Langley Research Center, Hampton, VA USA

**Flight Demonstration of Integrated Airport Surface Technologies for Increased Capacity and Safety**

Jones, Denise R., NASA Langley Research Center, USA; Young, Steven D., NASA Langley Research Center, USA; Wills, Robert W., NASA Langley Research Center, USA; Smith, Kathryn A., NASA Langley Research Center, USA; Shipman, Floyd S., NASA Langley Research Center, USA; Bryant, Wayne H., NASA Langley Research Center, USA; Eckhardt, Dave E., Jr., NASA Langley Research Center, USA; Feb. 1998; 30p; In English

A flight demonstration was conducted to address airport surface movement area capacity and safety issues by providing pilots with enhanced situational awareness information. The demonstration presented an integration of several technologies to government and industry representatives. These technologies consisted of an electronic moving map display in the cockpit, a Differential Global Positioning system (DGPS) receiver, a high speed very high frequency (VHF) data link, an Airport Surface Detection Equipment (ASDE-3) radar, and the Airport Movement Area Safety System (AMASS). Aircraft identification was presented to an air traffic controller on an AMASS display. The onboard electronic map included the display of taxi routes, hold instructions, and clearances, which were sent to the aircraft via data link by the controller. The map also displayed the positions of other traffic and warning information, which were sent to the aircraft automatically from the ASDE-3/AMASS system. This paper describes the flight demonstration in detail, along with test results.
Author
*Flight Tests; Data Links; Global Positioning System; Airports; Systems Integration; Man Machine Systems*


**19980033537**  Defence and Civil Inst. of Environmental Medicine, North York, Ontario Canada
**Surviving a Helicopter Ditching: An Engineering challenge**
Brooks, C. J., Defence and Civil Inst. of Environmental Medicine, Canada; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 8p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche
The audience today is primarily engineers, and the first objective is to convince them that flying a helicopter over water is more dangerous than flying a fixed wing aircraft over water. The evidence for this was first reported in 1984 by the UK Civil Aviation Authority (CAA) in the HARP Report (16). It concluded that the accident rate for helicopters operating over the North Sea was 2.0 per 100,000 flying hours compared to 0.4 for fixed wing aircraft. A subsequent review of accident data by the CAA (17) in 1995 reported that "In the 18 years from 1976 to 1993, the offshore industry has generated 2.2 million helicopter operating hours in the transportation of 38 million passenger for the loss of 85 lives in eight fatal accidents. This represented a fatality rate of 3.86 per 100,000 flying hours."
Derived from text
*Helicopters; Aircraft Configurations; Aircraft Accidents; Helicopter Control; Losses; Civil Aviation*


## 04
## AIRCRAFT COMMUNICATIONS AND NAVIGATION

*Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.*


**19980024026**  Michigan Univ., Transportation Research Inst, Ann Arbor, MI USA
**On-the-Road Human Factors Evaluation of the Ali-Scout Navigation System,** *Oct. 1994 - Mar. 1997*
Katz, S., Michigan Univ., USA; Fleming, J., Michigan Univ., USA; Green, P., Michigan Univ., USA; Hunter, D., Michigan Univ., USA; Damouth, D., Michigan Univ., USA; Mar. 1997; 270p; In Malay-Indonesian
Report No.(s): PB98-119084; UMTRI-96-32; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche
Two experiments examined the safety and usability of the Seimens Ali-Scout navigation system. The in-vehicle interface provides turn-by-turn visual and voice guidance. In the first experiment, 54 drivers varying in age drove to four destinations, twice using the Ali-Scout and once using experimenter verbal guidance. Subjects were tested in the afternoon, at rush hour, and in the evening. In the supplemental experiment, eye fixation data at night for the Ali-Scout was collected for 10 drivers. An additional three drivers used the PathMaster. There were no crashes, near misses, or critical incidents associated with the PathMaster. In contrast to the first experiment, measures of lateral control (lane position) were most sensitive to experimental differences.
NTIS
*Navigation Aids; Roads; Safety Factors; Lateral Control; Human Performance; Human Factors Engineering*


**19980029709**  Civil Aeromedical Inst., Oklahoma City, OK USA
**Cockpit Integration of GPS: Initial Assessment-Menu Formats and Procedures**  *Final Report*
Wreggit, Steven S., Civil Aeromedical Inst., USA; Marsh, Delbert K., II, Civil Aeromedical Inst., USA; Mar. 1998; 30p; In English
Report No.(s): DOT/FAA/AM-98/9; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A popular portable Global Positioning System (GPS) unit (Megellan EC-10X), representative of this class of devices, was examined for its usability by general aviation pilots. Nine private pilots participated in the experimentation, which was accomplished in three phases: familiarization and training, usability testing, and post-experiment debriefing. During familiarization and training, participants were asked to study flow diagrams representing GPS interface logic, observed a demonstration of the unit's features and procedures, and then were allowed to practice with the unit until they could demonstrate proficiency. During the usability testing phase, participants performed 37 GPS-related tasks requiring waypoint setting, GPS navigation, and general GPS-data entry and retrieval. Findings from videotape, questionnaire, and debriefing data indicated that a number of menu structures interfered with the pilots' successful entry of data, editing of stored data, and activation of functions. For example, one source of confusion resulting in excess button presses was the need to deactivate the flight plan before any editing could be done. Recommendations are made for defining the form of the interface structure in this class of devices, including: A given function should be consistently assigned to one button, feedback should be consistent and meaningful, and an "undo" or "back" function would be a very useful way to decrease the number of button presses required by this interface.
Author
*Global Positioning System; Cockpits; Flight Plans; Data Retrieval; General Aviation Aircraft*


**19980033148** Colorado Univ., Colorado Center for Astrodynamic Research, Boulder, CO USA
**GPS Based Attitude Determination for Spinning Satellites** *Final Report, 1 Sep. 1994 - 30 Jun. 1997*
Axeirad, Penina, Colorado Univ., USA; Behre, Charles P., Colorado Univ., USA; Dec. 10, 1997; 164p; In English
Contract(s)/Grant(s): N00014-94-I-1158
Report No.(s): AD-A334738; PA-97-060; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
This report describes the research performed by the Colorado Center for Astrodynamics Research (CCAR) under an AAS-ERT Grant to study Global Positioning System (GPS) based attitude determination for spinning satellite. Two key contributions are discussed- phase-based methods for estimation of the spin axis of a spinning satellite. and signal noise ratio (SNR) based methods for estimation of one or more spacecraft axes. The latter method, which is very robust and widely applicable, is demonstrated on actual flight data from three NASA missions. It provides instantaneous pointing knowledge at the 310 degree level with a single GPS antenna and is useful for attitude initialization, verification, GPS phase ambiguity resolution, and a reliable backup attitude determination sensor.
DTIC
*Astrodynamics; Attitude (Inclination); Global Positioning System*


**19980035006** Centre d'Essais en Vol, Base d'Essais d'Istres, Istres, France
**SYTRAM (Systeme de Trajectographie Multimobile): A New Guidance Method for Test of MultiTarget Airplanes**
*SYTRAM (SYsteme de TRajectographie Multimobile): Une Nouvelle Methode de Guidage des Avions Pour les Essais Multi-Cibles*
DeMalleray, E., Centre d'Essais en Vol, France; Advances in Flight Testing; Dec. 1997; 16p; In French; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche
SYTRAM has been developed based on a need by CEV (Centre d'Essais en Vol) to have an autonomous and precise guidance system for multi target testing. The multi target tests often require the development of precise scenarios that are difficult and even impossible without a high quality and continuous guidance system. Until now, these tests have been conducted with the assistance of guidance systems on the ground, transmitting their orders via radio. They can only follow one airplane with precision, and up to a maximum of 4 airplanes. Beyond that, several guiding systems would be necessary, but the radio would be saturated. SYTRAM is an ascending and descending liaison. The ascending liaison (60 KBIT/sec) of the system SYTRAM allows the conception of a function, named "Autonomous Guidance" which will produce guidance information to the equipment being tested, for autonomous installation, i.e. without the use of radiotelegraphy. Four guidance interfaces have been developed, the HUD, the HDD, and the Classic and Audio Instrumentations. The guidance law, common to all interfaces, was completed in the simulator in 3 weeks. In flight tests started with 3 flights on the ABE Mystere XX. The goal of these tests was to confirm the feasibility of the autonomous guidance function. The interface HDD was chosen for the tests but the capacity to modify the coefficients of the law of in-flight navigation was preserved. Finally, the application of the HDD symbology is under development on a liquid crystal screen.
Author
*Flight Tests; Autonomy; Navigation*

**19980035007**  Instituto Superior Tecnico, Lisbon,  Portugal

**European Flight Experiments on 4-Dimensional Approach and Landing with the CASA 212 Aviocar Aircraft**

Azinheira, J. R. C., Instituto Superior Tecnico, Portugal; Fonseca, A. A., Instituto Superior Tecnico, Portugal; Avello, C. Garcia, European Organization for the Safety of Air Navigation, Belgium; Swierstra, S., European Organization for the Safety of Air Navigation, Belgium; Advances in Flight Testing; Dec. 1997; 10p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Over the years a continuing increase in demand for air travel was observed that always surpassed the highest estimates. The capacity limit of the major airports constitutes one of the bottlenecks in the expansion of air transport. In order to maintain a competitive edge, air carriers use aircraft types that offer optimum economy on the routes they fly. In a typical hub operation, this results in a mixture of jet, turbo-prop and prop aircraft, each with a different operational speed range. Today for the main airports, the runway constitutes a major bottleneck. Accordingly the optimisation of the capacity of an airport becomes a very complex task when the stream of inbound aircraft consists of a mixture of aircraft types. The introduction of automated tools to enhance the efficiency of the air traffic controllers is one of the targets of the EATCHIP programme to improve the overall quality of the air traffic control services provided . Research programmes have led to the development of such tools, in particular to assist the air traffic controllers with the problem of optimum Arrivals Management. Meanwhile these tools have been tested and initially validated in simulation environments. The requirement existed to test and demonstrate algorithms developed using a real aircraft, initially in an isolated, well-controlled flight environment. This has led the EUROCONTROL Agency (EHQ, Brussels) and the Instituto Superior Tecnico (IST, Lisbon) to organize in close co-operation with Aeroportos e Navegacao Aerea (ANA, Lisbon) and Montijo) a live exercise to investigate the feasibility and performance of such a tool. This report describes the flight trials and some of the conclusions drawn. The references at the end of this text give a detail explanation of the different components that were used to perform these trials.
Author
*Air Transportation; Airports; Air Traffic Control; Flight Control*


**19980035009**  Technische Univ., Inst. of Flight Guidance, Brunswick,  Germany

**Ensuring the GNSS Onboard Integrity Function Under Adverse Conditions: Feasibility and Flight Test Results**

Butzmuehlen, Carsten, Technische Univ., Germany; Dec. 1997; 10p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

With an increasing system and technology performance of satellite navigation components, the Global Navigation Satellite Systems (GNSS) conquer more and more fields of military and civil applications. Due to the undisputed high level of accuracy and its marginal needs of terrestrial infrastructure, satellite navigation is in principle the most suitable candidate for positioning tasks under adverse environments where conventional radio navigation aids fail. Considering this background, the Institute of Flight Guidance and Control participated recently in a flight test program in Lugano, Switzerland supported by the Swiss Federal Office of Aviation (FOCA). Flight tests were performed under highly dynamic and adverse conditions with the additional use of low-cost inertial information. The landscape in which these test were realized leads to the risk of extensive shadowing of the space vehicles, thus increasing the probability that the GNSS is not available in order to compute a position solution. Additionally, the mountains provide a reflecting surface of the radio frequency signals. Hence, the possibility of multipath reception is given here as well. This paper deals with the current means that are used to achieve the accuracy and the integrity that is necessary for high-precision and safety-critical procedures. The methods are discussed briefly and flight test results are presented.
Author
*Feasibility; Flight Tests; Data Acquisition; Navigation Satellites; Navigation Aids*


**19980035018**  National Research Council of Canada, Research Test Pilot, Ottawa, Ontario Canada

**Performance and Guidance System Testing Using Differential GPS on a Falcon 20 Aircraft**

Croll, John B., National Research Council of Canada, Canada; Advances in Flight Testing; Dec. 1997; 8p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Using a Falcon 20 research aircraft, a program was conducted at the Canadian National Research Council (CNRC) to investigate the use of a differential Global Positioning System (GPS) to: (1) provide aircraft guidance on precision instrument approaches, and (2) measure aircraft performance parameters during typical flight test manoeuvres needed for aircraft certification. The initial series of tests used a differential GPS with NovAtel 95 IR receivers installed in the aircraft and at the ground station, and with a VHF radio link to provide real-time differential corrections. This system fell slightly short of the vertical accuracy criteria needed for precision approaches to Category I limits, and did not meet the accuracy criteria desired for flight test measurement. Following an upgrade to a NovAtel RT-20(trademark) differential GPS, a program was conducted to determine the landing performance of the Falcon 20 on winter contaminated runways (covered with ice or snow). The real-time position and height accu-

racies of the upgraded system were determined to be less than 20 centimeters, falling well within the accuracy criteria for Category I approaches, and enabling this system to be used as the primary device for measuring aircraft landing distances from a height of 50 feet (15 meters) to a complete stop. During this program, a strong correlation was found between aircraft deceleration during full braking and the runway friction index reported by a ground test vehicle, allowing the aircraft landing distance to be accurately predicted as a function of the runway friction index.

Author

*Aircraft Guidance; Aircraft Performance; Certification; Correction; Flight Tests; Ground Tests; Instrument Approach*

**19980035019** Technische Univ., Inst. of Flight Mechanics and Flight Control, Munich, Germany

**Precision Navigation and Synthetic Vision for Poor Visibility Guidance**

Sachs, G., Technische Univ., Germany; Dobler, K., Technische Univ., Germany; Schaenzer, G., Technische Univ., Germany; Dieroff, M., Technische Univ., Germany; Dec. 1997; 12p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Computer generated synthetic vision is considered as a means for providing guidance in poor visibility conditions. The synthetic vision comprises as basic elements a 3-dimensional image of the outside world and integrated guidance information like a tunnel display. A precision navigation system is applied which couples differential satellite and inertial sensor data to achieve the required high performance. A flight test program was conceived to cover a wide range of synthetic vision guidance applications (precision approach and landing, low level flight in narrow river valley, curved/steep/short approaches and terrain following in mountainous areas). Four test series at different areas were conducted. The results of the flight test program show that the synthetic vision enables the pilot to precisely control the aircraft. He successfully performed the flight tasks.

Author

*Visual Control; Navigation; Precision; Flight Tests; Display Devices*

**19980035020** National Research Council of Canada, Flight Research Lab., Ottawa, Ontario Canada

**Validation of the Simultaneous Calibration of Aircraft Position Error and Airflow Angles Using a Differential GPS Technique on a Helicopter**

Hui, Kenneth, National Research Council of Canada, Canada; Baillie, Stewart, National Research Council of Canada, Canada; Dec. 1997; 8p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper describes the validation of a technique for the simultaneous determination of pitot-static position error and the calibration curves for angle of attack and sideslip sensors. The Simultaneous Calibration of AirData system (SCADS) technique involves flying the aircraft in a 'wind box' pattern while recording a suite of standard flight test parameters and Differential Global Positioning System (DGPS) measurements. This simultaneous calibration technique combines the calibration procedure for both position error and airflow angle calibration, and eliminates the need for flying close to the ground during the tests. During the development of this technique using the NRC Falcon 20 aircraft, the results demonstrated that accurate calibrations could be obtained with reduced flight time and cost over conventional calibration techniques. The present paper describes the application of the SCADS technique to the NRC Bell 206B helicopter. The calibration results are presented and are compared with data from other standard calibration methods and verified with manoeuvres not used in the model development. The results from using the SCADS technique have demonstrated better efficiency and accuracy.

Author

*Calibrating; Position Errors; Angle of Attack; Bell Aircraft; Proving*

**19980036302** Defence Research Establishment Ottawa, Ottawa, Ontario Canada

**Measurements of Multipath and Its Effects on Terrestrial VHF Radio Direction Finding**

Read, William J., Defence Research Establishment Ottawa, Canada; Dec. 1997; 88p; In English

Report No.(s): AD-A335551; DREO-1325; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report details the investigation of VHF radio direction finding (DF) and the effects of multipath propagation for terrestrial paths. For this investigation, an eight channel DF system was used to make field measurements of a transmitter as it was slowly moved along a designated route. This allowed the fine scale effects of multipath on the measured signal bearing and power to be observed - effects which had been previously observed as being noise like in nature. Computer modeling was also used in order to develop simulations able to reproduce the effects observed in the field measurements. This has lead to the identification of the main sources of multipath, and a statistical assessment of their numbers and distribution. The computer models also allowed other factors affecting DF accuracy to be investigated which include: the transmitter receiver path length, the size of the clearing at the

DF site, the DF antenna height, and the DF algorithm. The main conclusions are that multipath is a major impediment to very high accuracy DF for terrestrial VHF DF systems, but that steps can be taken to mitigate its effects.
DTIC
*Direction Finding; Multipath Transmission; Very High Frequencies*


**19980036369**  Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
**User Location Determination Strategy in a Low Earth Orbit Satellite Network**
Lee, Jaehee, Air Force Inst. of Tech., USA; Dec. 1997; 80p; In English
Report No.(s): AD-A335745; AFIT/GCS/ENG/97D-06; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Recently, many Low Earth Orbit (LEO) satellite systems have been proposed for the purpose of global communication and one of those systems is planned to start the commercial service in 1998. These LEO satellite systems are providing most of current communication services (voice, fax, data, paging, and even real time video service) without any limitation on place and time. However, little is published about their detail system methodology on user tracking and managing schemes. This thesis presents two user location tracking algorithms in a LEO environment. One (Gateway Approach) is the most likely approach under present system proposals, while the other (Satellite Approach) requires more risk in implementing the proposed scheme. These two approaches are compared via computer simulation in an Iridium-like satellite network system environment. Comparative measures of call setup delay and number of hops needed to establish initial call request are examined, and minimum requirements for the Satellite Approach are discussed. It is concluded that the Satellite Approach performs better than the Gateway Approach when the memory space and computational ability of each satellite can satisfy the minimum conditions discussed in this paper. Also, the Satellite Approach experienced well balanced message distribution than the Gateway Approach. Moreover, as far as system survivability and service continuity, the Satellite Approach showed more advantageous factors than the Gateway Approach.
DTIC
*Low Earth Orbits; Satellite Networks; Satellite Communication; Computerized Simulation; Earth Orbital Environments; Tele-communication*


# 05
# AIRCRAFT DESIGN, TESTING AND PERFORMANCE

*Includes aircraft simulation technology.*


**19980024763**

**Society of Flight Test Engineers, Annual Symposium, 21st, Garden Grove, CA, Aug. 6-10, 1990, Proceedings**
1990; In English; ISBN 1050-9690; Copyright; Avail: Aeroplus Dispatch

Various papers on flight tests are presented. Individual topics addressed include: digital Doppler rate-of-descent indicator, flight testing a digital terrain-following system, state-of-the-art airborne video recording, flying qualities testing on the modern technology airship, the High-Technology Test Bed, variable capacitance accelerometer for flight test measurements, helicopter in-flight frequency response testing techniques, limit cycle oscillation and flight flutter testing, Fokker 50 flameouts in icing conditions, SAS flight analysis and aircraft monitoring system. Also discussed are: research flight test of a scaled unmanned air vehicle, real-time data acquisition for expert systems in UNIX workstations at Space Shuttle Mission Control, AV-8B VSTOL performance analysis, low-profile microsensor for aerodynamic pressure measurement, in-flight targeting techniques for ground-based hover testing, dealing with pilot response time in failure case testing, development of pitot static flightline testing.
AIAA
*Conferences; Flight Tests*


**19980024830**

**Nonstationary theories of the pneumatic tire and the wing and their application to aircraft shimmy analysis** *Niestacjo-narne teorie pneumatyka i plata i ich zastosowanie do analizy shimmy samolotu*
Goraj, Zdobyslaw J., Politechnika Warszawska, Poland; Politechnika Warszawska, Prace Naukowe, Mechanika; 1991; ISSN 0137-2335, no. 146, pp. 3-139; In Polish; Copyright; Avail: Aeroplus Dispatch

Various theories of the pneumatic tire and the wing are examined in a critical manner from the standpoint of their utility to wheel shimmy analysis. The existing nonstationary weightless tire theories are compared, and it is shown that all of these theories can be derived from the equation of nonholonomic constraints and the equation of tire balance. A new general theory for the pneumatic tire is developed, which is an extension of the theory of von Schlippe and Dietrich (1954). The general theory is universally applicable, provides superior numerical accuracy, and allows a mathematical expression in the form of ordinary differential equa-

tions for the forces and moments acting on the tire. A method derived from a flutter analysis method is adapted to the analysis of the critical speed of wheel shimmy. A numerical method for calculating the nonstationary aerodynamic derivatives is also presented which is derived from the DLM panel method.

*Aircraft Tires; Aerodynamic Stability; Structural Vibration; Self Excitation; Aircraft Stability; Ground Speed*

**19980025468** NASA Langley Research Center, Hampton, VA USA

**Engineering Aerothermal Analysis for X-34 Thermal Protection System Design**

Wurster, Kathryn E., NASA Langley Research Center, USA; Riley, Christopher J., NASA Langley Research Center, USA; Zoby, E. Vincent, NASA Langley Research Center, USA; 1998; 22p; In English; 36th; Aerospace Sciences Meeting and Exhibit, 12-15 Jan. 1998, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA/TM-1998-207439; NAS 1.15:207439; AIAA Paper 98-0882; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

　　Design of the thermal protection system for any hypersonic flight vehicle requires determination of both the peak temperatures over the surface and the heating-rate history along the flight profile. In this paper, the process used to generate the aerothermal environments required for the X-34 Testbed Technology Demonstrator thermal protection system design is described as it has evolved from a relatively simplistic approach based on engineering methods applied to critical areas to one of detailed analyses over the entire vehicle. A brief description of the trajectory development leading to the selection of the thermal protection system design trajectory is included. Comparisons of engineering heating predictions with wind-tunnel test data and with results obtained using a Navier-Stokes flowfield code and an inviscid/boundary layer method are shown. Good agreement is demonstrated among all these methods for both the ground-test condition and the peak heating flight condition. Finally, the detailed analysis using engineering methods to interpolate the surface-heating-rate results from the inviscid/boundary layer method to predict the required thermal environments is described and results presented.

Author

*Aerothermodynamics; Thermal Protection; Computational Fluid Dynamics; Wind Tunnel Tests; Flow Distribution; X-34 Reusable Launch Vehicle; Navier-Stokes Equation*

**19980025558** Naval Postgraduate School, Monterey, CA USA

**Structural Design Analysis of the Tail Landing Gear Bay and the Vertical/Horizontal Stabilizers of the RAH-66 Comanche Helicopter**

Shoop, Brian P., Naval Postgraduate School, USA; Sep. 1997; 80p; In English

Report No.(s): AD-A333345; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

　　The RAH-66 Comanche's stealth design requires the use of radar-absorbing material (RAM) on the outer skin of the aircraft. The reduced stiffness properties of RAM produce insufficient tail torsional stiffness, necessitating the use of non-radar-absorbing graphite on the outer skin of the tail section. This thesis investigates structural design modifications to increase the tail section's stiffness to allow the use of RAM on the outer skin and still meet all structural requirements. An original model represents the prototype aircraft at first flight. The goal is to create a model using RAM on the outer skin that watches the structural stiffness of the original model. This thesis builds on earlier work conducted at the Naval Postgraduate School (NPS). Two new design modifications to the tailbone are developed. The best modification increases the torsional stiffness of a baseline model by six percent. Integrating earlier NPS modifications increases torsional stiffness by 12 percent. When RAM is applied to the outer skin of the modified model, torsional stiffness is reduced by only six percent from the baseline as compared to a 2 4 percent reduction with no modifications. Additional modifications to the vertical and horizontal stabilizers further increase structural stiffness and reduce weight.

DTIC

*Aircraft Models; Design Analysis; Helicopters; Landing Gear; Structural Design; Weight Reduction*

**19980026165**

**Calculation, design, and construction of ultralight aircraft** *Raschet, proektirovanie i postrojka sverkhlegkikh samoletov*

Chumak, Pavel I., Russia; Krivokrysenko, Vladimir F.; 1991; In Russian; ISBN 5-7030-0224-9; Copyright; Avail: Aeroplus Dispatch

　　The book is concerned with the various aspects of the analysis, design, and construction of ultralight aircraft of classical configurations. In particular, attention is given to determining the principal parameters and general design of ultralight aircraft, calculating the takeoff weight and the principal flight performance characteristics, fundamentals of the strength analysis of structural

elements, and calculating and designing the main aircraft components. The discussion also covers the selection of the engine type and engine supercharging, various methods of propeller design, and manufacture of the airframe, wing, and propeller.

AIAA

*Aircraft Design; Aircraft Configurations; Aircraft Structures; Ultralight Aircraft*


**19980027034** Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

**Comparison of Analytical Crack Growth Modelling and the A-4 Wing Test Experimental Results for a Fatigue Crack in an F-111 Wing Pivot Fitting Fuel Flow Hole Number 58**

Murtagh, B. J., Defence Science and Technology Organisation, Australia; Walker, K. F., Defence Science and Technology Organisation, Australia; Sep. 1997; 27p; In English

Report No.(s): AD-A334847; DSTO-TN-0108; DODA-AR-010-319; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report details a series of analyses which were performed to develop expertise and evaluate the performance of several fatigue crack growth prediction computer codes. The analyses were performed for the case of a fatigue crack in the lower plate of the F-111 Wing Pivot Fitting, adjacent to Fuel Flow Hole No 58. This location is a known fatigue critical location and is designated as DI 86. Fatigue cracking leading to failure occurred at this location on the A-4 wing full scale fatigue test after approximately 12,200 hours of testing. An experimentally derived crack growth curve was available from the A-4 wing test. Analytical models were developed using conventional LEFM software codes (FractuREsearch and AFGROW) and the analytical crack closure code, FASTRAN II. The analysis results were compared with the experimental result and also with the analysis originally performed by the manufacturer, General Dynamics. Consistent with previous work, the analytical crack closure code, FASTRAN II, produced the most consistent and accurate results.

DTIC

*Crack Propagation; Computer Programs; Mathematical Models; Crack Closure; Fatigue (Materials)*


**19980027590** Aircraft Research and Development Unit, Edinburg, Australia

**AS350BA Squirrel Hydraulics Out Evaluation**

Langley, A. J., Aircraft Research and Development Unit, Australia; Sep. 1997; 84p; In English

Report No.(s): AD-A334852; ARDU-TASK-0301; DODA-AR-009-993; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Task 0301 was an evaluation of the Hydraulics OUT characteristics of the AS35OBA Squirrel Helicopter. This report documents the results of that task.

DTIC

*Helicopters; Controllability; Hydraulic Equipment; Flight Tests*


**19980030363**

**Developments in adhesively bonding the wings of the SAAB 340 and 2000 aircraft**

Hart-Smith, L. J., Douglas Aircraft Co., USA; Strindberg, G.; Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering; 1997; ISSN 0954-4100; Volume 211, no. 3, pp. 133-156; In English; Copyright; Avail: Issuing Activity

The bonding tool designs for the wing of the SAAB 340 and 2000 aircraft and the manufacture of the Primary Adhesively Bonded Structure Technology (PABST) fuselage were implemented during the production transfer of the wing to Sweden. The transfer eliminated all fit problems, production of more uniform void-free bond line and effective bagging procedures. All breather and bleeder layers have been eliminated, reducing costs and disposal of expendable materials. The transfer was so complete that the tooling technology has since been improved upon. The bonding of the stiffened wing skins for these two aircraft is probably the most advanced and simultaneously the most forgiving production application of large-scale metal bonding the world has yet seen.

EI

*Adhesive Bonding; Saab Aircraft; Bonding; Wings; Fuselages; Technology Transfer*


**19980030781** NASA Langley Research Center, Hampton, VA USA

**Design of Three-Dimensional Hypersonic Inlets with Rectangular to Elliptical Shape Transition**

Smart, M. K., NASA Langley Research Center, USA; 1998; 16p; In English; 36th; Aerospace Sciences Meeting and Exhibit, 12-15 Jan. 1998, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

A methodology has been devised for the design of three-dimensional hypersonic inlets which include a rectangular to elliptical shape transition. This methodology makes extensive use of inviscid streamtracing techniques to generate a smooth shape transition from a rectangular-like capture to an elliptical throat. Highly swept leading edges and a significantly notched cowl enable use of these inlets in fixed geometry configurations. The design procedure includes a three dimensional displacement thickness calculation and uses established correlations to check for boundary layer separation due to shock wave interactions. Complete details of the design procedure are presented and the characteristics of a modular inlet with rectangular to elliptical shape transition and a design point of Mach 7.1 are examined. Comparison with a classical two-dimensional inlet optimized for maximum total pressure recovery indicates that this three-dimensional inlet demonstrates good performance even well below its design point.
Author
*Design Analysis; Three Dimensional Models; Hypersonic Inlets; Elliptical Cylinders; Rectangular Plates; Shapes*

**19980032587**  NASA Langley Research Center, Hampton, VA USA
**Subsonic Maneuvering Effectiveness of High Performance Aircraft Which Employ Quasi-Static Shape Change Devices**
Montgomery, Raymond C., NASA Langley Research Center, USA; Scott, Michael A., NASA Langley Research Center, USA; Weston, Robert P., NASA Langley Research Center, USA; 1998; 14p; In English; 36th; 5th; Smart Structures and Materials, 1-6 Mar. 1998, San Diego, CA, San Diego, CA, USA, USA; Sponsored by International Society for Optical Engineering, USA

This paper represents an initial study on the use of quasi-static shape change devices in aircraft maneuvering. The macroscopic effects and requirements for these devices in flight control are the focus of this study. Groups of devices are postulated to replace the conventional leading-edge flap (LEF) and the all-moving wing tip (AMT) on the tailless LMTAS-ICE (Lockheed Martin Tactical Aircraft Systems - Innovative Control Effectors) configuration. The maximum quasi-static shape changes are 13.8% and 7.7% of the wing section thickness for the LEF and AMT replacement devices, respectively. A Computational Fluid Dynamics (CFD) panel code is used to determine the control effectiveness of groups of these devices. A preliminary design of a wings-leveler autopilot is presented. Initial evaluation at 0.6 Mach at 15,000 ft. altitude is made through batch simulation. Results show small disturbance stability is achieved, however, an increase in maximum distortion is needed to statically offset five degrees of sideslip. This only applies to the specific device groups studied, encouraging future research on optimal device placement.
Author
*Aircraft Maneuvers; Flight Control; Computational Fluid Dynamics; Fighter Aircraft; Control Equipment; Leading Edges*

**19980033522**  Northrop Grumman Corp., Pico Rivera, CA USA
**Affordable Structures Through Integrated Design**
Wiley, D., Northrop Grumman Corp., USA; Sensburg, O., Daimler-Benz Aerospace A.G., Germany; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 10p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Design for Affordability is the new paradigm for the 21st Century. Balancing the conflicting goals of systems superiority and systems affordability is the challenge of the integrated design environment on a larger scale than has ever been done before. This paper discusses the engineering processes and tools of Integrated Design which contribute to affordability of combat aircraft structures. The objectives of integrated design are to ensure a balanced design so that no single performance parameter dominates the system and to manage the design achieves the optimum in system level performance and affordability. Analyses and simulations reduce the risk in the preliminary design phase, minimizing the amount of testing required for validation prior to production.
Derived from text
*Aircraft Structures; Fighter Aircraft; Aircraft Design; Optimization; Balancing*

**19980033525**  Defence Evaluation Research Agency, Systems Integration Dept., Farnborough,  UK
**Synthetic Environments - A Tool in Combat Aircraft Design**
Weeks, R., Defence Evaluation Research Agency, UK; Tomlinson, B., Defence Evaluation Research Agency, UK; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 5p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

Combat aircraft design is a complex task requiring a balance to be struck between potentially conflicting requirements. Most recently the very practical consideration of affordability has come to dominate almost every phase of the process. However, the requirement for effectiveness remains. This paper considers how the application of large scale simulation and modelling - dubbed 'Synthetic Environments' can already assist in understanding the issues and trade-offs and goes on to suggest how the potential

of the approach may in due course extend to a far wider range of applications. The paper draws on examples of research into Synthetic Environments as an approach and will address some of the work on SEs and their applications in which the UK Defence Evaluation and Research Agency is involved.
Derived from text
*Aircraft Design; Fighter Aircraft; Simulation; Costs; Tradeoffs*


**19980033527** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Aeroelasticity, Goettingen, Germany
**The Benefits of the Passive and Active Aeroelastic Design of Aircraft Structures**
Hoenlinger, H. G., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Hutin, P. M., Office National d'Etudes et de Recherches Aerospatiales, France; Pendleton, E. W., Wright Lab., USA; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 24p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The increasing performance requirements and the economical pressure to reduce Direct Operational Costs (DOC's) of new aircraft design can no longer be met by traditional and sequential design processes. This is especially true when considering aeroelasticity. The impact of aeroelastic effects on the design of new high performance transport or fighter aircraft demands the use of multidisciplinary design concepts and optimization strategies in the preliminary design phase or earlier to develop flutter-free structures and to ensure excellent multipoint design characteristics. This paper presents selected examples of a variety of aeroelastic design principles for passive primary aircraft structures and for active structures of advanced aircraft with highly sophisticated fly-by-wire flight control systems.
Derived from text
*Aeroelasticity; Aircraft Design; Cost Reduction; Aircraft Structures; Fighter Aircraft; Multidisciplinary Design Optimization; Operating Costs; Design Analysis*


**19980033530** Naval Air Systems Command, Arlington, VA USA
**V/STOL and STOVL Design Considerations**
McErlean, Donald P., Naval Air Systems Command, USA; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 4p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

As has been noted in many studies of this class of aircraft (cf "Aircraft Design Integration" L.M.D.C. Campos, Aerospace 2020) full vertical take off and landing of attack type aircraft (non-rotor powered) has been shown to be an unwise design option. This is due primarily to the substantial amount of thrust which must be provided for vertical lift severely limiting gross weight and therefore either payload or range. However, if even a limited amount of forward motion is provided, so that a conventional lifting wing augments the vertical thrust of the propulsion system the situation changes considerably. This combination of wing and propulsion produced lift has been shown to provide both useful payload/range combinations and significantly shortened take-off roll. Upon completion of the mission, with either payload expended or fuel load consumed, the system is now sufficiently lighter so that vertical landing does become possible. This gives rise to a class of aircraft known as "STOVL" or Short Take Off/Vertical Landing. Obviously one could also design the aircraft with shortened landing distances but not truly vertical. However, an interesting systems trade comes to bear on the problem.
Derived from text
*V/STOL Aircraft; Aircraft Design; Takeoff; Vertical Landing; Attack Aircraft*


**19980033533** Wright Lab., FIIA, Wright-Patterson AFB, OH USA
**A Discussion of a Modular Unmanned Demonstration Air Vehicle**
Cherry, Mark C., Wright Lab., USA; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 9p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The idea of an unmanned combat vehicle has existed for many years. We now have the opportunity to capitalize on numerous technologies under development to make an unmanned combat vehicle a viable option for military commanders. The key problems are the issues dealing with the integration of these technologies into a synergistic aeroform, and the human control problems that arise due to these technologies. A modular demonstration platform that can capitalize on new technologies as they mature is a key way to demonstrate the viability of an unmanned combat vehicle, as well as answer some of the questions, and technology challenges, that may arise due to off-board control of a lethal air vehicle. A modular airframe is required in a demonstration platform to flight test and demonstrate various technology sets as they mature. Modularity is important because it provides greater system flexibility and should reduce the life cycle costs of the air vehicles. The demonstration platform must be capable of per-

forming a notional mission similar to what may be envisioned for a combat UAV, in order to show that demonstrated technologies are applicable to production vehicles. The challenges and payoffs of this aggressive vision will be discussed.
Derived from text
*Airframes; Cost Reduction; Modularity; Flight Tests; Life Cycle Costs; Combat*


**19980033534**  R-Tec, Rolling Hills Estates, CA USA
**Aging Airframes and Engines**
Ratwani, Mohan M., R-Tec, USA; Koul, A. K., Institute for Aerospace Research, Canada; Immarigeon, J-P., Institute for Aerospace Research, Canada; Wallace, W., Institute for Aerospace Research, Canada; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 16p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The presence of aging aircraft fleets has been increasing throughout the world due to the global, financial, and political environment. The reduction in the defense budget of many countries has forced them to use their military aircraft well beyond their original design lives. Also, the demand on the performance of these aircraft has been increasing due to increased payload and severe usage. Maintaining the airworthiness of these aircraft and their propulsion systems while at the same time keeping the maintenance costs low is of prime concern to the operators and regulatory authorities. The flight safety requirements and the performance demands are likely to result in higher maintenance costs. However, the unique opportunities provided by the research and development in the areas of new and improved materials, structures, manufacturing, repairs, and Non-Destructive Inspection (NDI) technologies have made it possible to keep the increase in costs to a minimum and in many cases reduced the overall maintenance costs. This paper discusses the contributions made by research and technology towards lowering the maintenance cost and improving the flight safety of aging airframes and engines.
Derived from text
*Airframes; Flight Safety; Aircraft Reliability; Payloads; Inspection; Costs; Propulsion System Performance*


**19980033536**  Defense Advanced Research Projects Agency, Arlington, VA USA
**Smart Aircraft Structures**
Crowe, C. Robert, Defense Advanced Research Projects Agency, USA; Sater, Janet M., Institute for Defense Analyses, USA; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 16p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The broad but strongly interdisciplinary field of smart structures and materials seeks to apply multi-functional capabilities to existing and new structures. by definition, smart structures and materials are those which can sense external stimuli and respond with active control to that stimuli in real or near-real time. The most common analogy is to a human (Figure 1): the nervous system senses the stimuli; then the brain processes the information causing a muscle (actuator) to respond. For purposes of this paper, smart structures and materials consist of active devices-primarily sensors and actuators either embedded in or attached to a structure. Smart structures analogy to a human. These smart structures technologies are expected to provide new and innovative capabilities in future military aircraft including fighter and transport aircraft, unmanned aerial vehicles (UAVs), and helicopters and tilt rotorcraft. Specific applications are described in terms of system functional capability enhancements (e.g., vibration damping and suppression) and overall system performance benefits (e.g., reduced life cycle costs).
Derived from text
*Smart Structures; Aircraft Structures; Cost Reduction; Fighter Aircraft; Real Time Operation; Sensory Perception; Actuators; Embedding*


**19980035012**  Defence Test and Evaluation Organisation, Rotary Wing Aircraft Dept., Boscombe Down,  UK
**Service Release and 'Safety Critical' Software**
Rodger, K. S., Defence Test and Evaluation Organisation, UK; Advances in Flight Testing; Dec. 1997; 10p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

As is well known, software is increasingly used to improve operational effectiveness. It is also well known that every innovative use of technology results in a change to the types of hazard and therefore introduces the potential for reduced safety. This paper considers what is required to recommend release of aircraft into service when safety is dependent on the "correct" operation of software. The paper starts with a general description of a release to service and of how it should be derived and continues with a discussion of testing its and roles, contributions and its limitations. Since software is inevitably associated with electronics the paper next considers how the safety implications of using electronics should be assessed before consideration of how safety critical

software should be treated by certifying authorities. The views expressed in this paper are those of the author and are not necessarily DTEO policy.

Author

*Computer Programs; System Effectiveness; Flight Safety*


**19980035013** Tybrin Corp., Edwards AFB, CA USA

### C-17 Enhancements to a Flight Test Planning Program

Canody, Cheryl, Tybrin Corp., USA; Hewett, Marle D., G and C Systems, Inc., USA; Advances in Flight Testing; Dec. 1997; 10p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper presents the enhancements incorporated into TEST_PLAN, a commercially available flight test planning program, for the C-17 follow-on test program. TEST_PLAN is a software package for UNIX and VMS based workstation computers that allows Flight Test Engineers (FTE's) to plan and track flight test programs by mapping requirements to test points, flights, and flight test maneuvers. TEST_PLAN is integrated with the Oracle Relational DataBase Management System (RDBMS). Test points and requirements are stored in Oracle tables. The software provides automated tools that allows FTE's to query these tables to obtain lists of test points that can be assigned to maneuvers and flights to construct a flight test plan. The 417th Flight Test Squadron (FLTS) at the Air Force Flight Test Center (AFFTC), Edwards Air Force Base (AFB), funded four major enhancements to TEST_PLAN to support the C-17 follow-on flight test program. These enhancements are: (1) incorporation of the C-17 Test Parameter Requirements (TPR) database into TEST_PLAN; (2) implementation of an Instrumentation Discrepancy Report in TEST_PLAN; (3) integration of FrameMaker with TEST_PLAN to implement an automated flight test card generation facility; and (4) instituting a requirements compatibility matrix using Oracle tables and compatibility definitions provided by the administrator. The details of these enhancements are presented in this paper.

Author

*C-17 Aircraft; Flight Tests; Data Base Management Systems; Applications Programs (Computers); Planing*


**19980035015** Defence Test and Evaluation Organisation, Rotary Wing Aircraft Dept., Boscombe Down, UK

### Helicopter Certification-The Challenge of Testing UK Apache

Finch, Roger S., Defence Test and Evaluation Organisation, UK; Advances in Flight Testing; Dec. 1997; 14p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

In July last year the UK Government announced the eagerly awaited decision on the UK Army's future Attack Helicopter (AH). The UK would purchase 67 WAH-64 APACHE helicopters, a derivative of the McDonnell Douglas Helicopters AH-64D Apache. The aircraft would be produced by GKN Westland Helicopters Ltd, as the Prime Contractor, with McDonnell Douglas Helicopter Systems as the Integrating Sub-Contractor. The WAH-64 would be fitted with a version of the Rolls Royce-Turbomeca RTM 322 engine, currently fitted to the UK's Merlin helicopter. The paper presents an overview of the emergent technologies being considered for the UK Apache, in particular a Defensive Aids Suite (DAS) and Helmet Mounted Displays (HMD). Ideas on a future handling qualities assessment are also presented. Before the first UK Apache arrives at Boscombe Down for clearance testing, the UK Test & Evaluation (T&E) community must develop the required clearance methodologies to evaluate the aircraft as a complete weapons system: preliminary work addressing this issue has already started. Clearance testing will, undoubtably, make greater use of simulation, as well as placing more emphasis on joint testing with Industry. The challenge facing UK T&E is how to acquire the required test data with the minimum amount of testing to generate the evidence necessary for the aircraft's Military Aircraft Release (MAR).

Author

*Helicopter Control; Certification; Helmet Mounted Displays; Military Helicopters*


**19980035017** Arnold Engineering Development Center, DOM, Arnold AFS, TN USA

### Balancing Modeling and Simulation With Flight Test in Military Aircraft Development

Norton, William J., Arnold Engineering Development Center, USA; Dec. 1997; 26p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The use of Modeling and Simulation (M&S) in the development of aerospace vehicles has evolved in step with the associated analytical and computational tools. During this evolution M&S has been balanced with necessary levels of flight testing as an integral part of the development process. Now, program managers are being urged to seek dramatic reductions in flight testing and to compensate with much greater reliance on M&S. A strong emphasis on fostering M&S development is essential to extend the aerospace state-of-the-art, and does hold promise for reducing development cost and cycle time. However, recent test programs do not provide confidence that M&S tools are presently of sufficient accuracy to permit a preponderant reliance on them at the expense of flight test. Premature dependency will introduce the risk that the system deficiencies usually found in flight testing

will go undiscovered until after the vehicle is in production and operation. However, a concerted effort to research and correct demonstrated M&S failures to predict certain system characteristics will, given time, allow a complementary reduction in flight testing. This would allow the shifting balance of M&S with flight testing to be managed so as to keep program risks acceptable and ensure the high quality of resulting weapons systems.
Author
*Balancing; Models; Simulation; Flight Tests; Software Development Tools; Attack Aircraft*


**19980035022**  British Aerospace Defence Ltd., Military Aircraft Div., Preston,  UK
**The Development and Use of In-Flight Analysis at BAE Warton**
Nanson, K. M., British Aerospace Defence Ltd., UK; Ramsay, R. B., British Aerospace Defence Ltd., UK; Dec. 1997; 16p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche
This paper describes the development and use of telemetry and in-flight analysis for flight trials at BAe Flight Test Warton. The current status of in-flight aerodynamic analysis techniques for Eurofighter is described, including those used for envelope expansion flutter testing. The cost benefits of monitoring and analysis, and the improvement in timescale of data availability, have been demonstrated to support the extension of the in-flight analysis concept to the complete weapon system flight trails.
Author
*Telemetry; Flight Tests; Aerodynamic Characteristics; Technologies*


**19980035023**  Computer Sciences Corp., El Segundo, CA USA
**Redefining Flight Testing: Innovative Application of the World Wide Web**
Hughes, Michael C., Computer Sciences Corp., USA; Gardner, Lee S., Air Force Flight Test Center, USA; Painter, Darcy S., Air Force Flight Test Center, USA; Dec. 1997; 8p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche
Application of World Wide Web technology to Flight Test is discussed. Examples of how efficiencies in processing flight test data have been gained using an "Intranet" are presented. The Air Force Flight Test Center has successfully used an Intranet to reduce the support staff for post-flight data processing by 90% over the past four years. Techniques are discussed, illustrated by examples, to demonstrate that Intranets have broad application to the Flight Test business. The application of Web technology to manage financial data in the EDGE project is discussed.
Author
*Flight Tests; Technology Utilization; Data Processing*


**19980035024**  Aerospatiale, Direction des Essais en Vol, Toulouse,  France
**In-Flight Tests of the A300-600-ST 'Beluga'**  *Essais en Vol de L'A300-600-ST 'Beluga'*
Destarac, Guy, Aerospatiale, France; Dec. 1997; 8p; In French; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche
In-flight tests of the A 300-600 ST 'Beluga', built by Aerospatiale and Daimler Benz Aerospatiale Airbus, were given to the Direction des Essais en Vol of the Branche Anions de l'Aerospatiale. This paper describes the installation of measures and the tools mounted on the first airplane for development and certification in-flight tests. It shows the means utilized for data processing and acquisition. The evaluation at the end of the test campaign shows that: the unexpectedly good behavior of the airplane in flight has compensated for the time required to resolve structural problems, the development of the charging system took longer than expected but did not delay the certification flights which were completed by the end of July 1995.
Author
*In-Flight Monitoring; Data Processing; Data Acquisition*


**19980035025**  Divisione Aerea Studi Ricerche e Sperimentazioni, Reparto Sperimentale Volo, Pratica di Mare,  Italy
**The Certification Process of the OPHER Smart Munition on the AMX Aircraft**
Petraroli, E., Divisione Aerea Studi Ricerche e Sperimentazioni, Italy; Israeli, D., Elbit Systems Ltd., Israel; Advances in Flight Testing; Dec. 1997; 12p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Italian Air Force (ITAF) has been seeking a low cost smart munition capable to attack vehicular targets with particular reference to armored vehicles and tanks. Low cost implies a guided weapon such as a laser bomb. The main objections to a laser guided weapon, such as those ones belonging to the Paveway family, derived from two intrinsic limitations: laser bombs require an illuminator (not a fire-and-forget weapon); and overall accuracy decreases dramatically with delivering energy. On the other hand, adoption of a missile would have increased both integration and procurement costs. So, it was decided to test the OPHER system in a different scenario with respect to that one which the system was originally designed for: (1) the Italian scenario, characterized by Mediterranean scrub, could have affected system performance in a different way with respect to Israeli desert; (2) the AMX can deliver weapons with an energy much lower than the F-4, on which this weapon has been employed in the Israeli Air Force; and (3) the AMX is equipped with a twin store carrier and the F-4 version of the OPHER system could not fit on it. The result of the successful testing and analytical work described in this paper led to the certification of the OPHER smart munition on the AMX for the Italian Air Force.
Author
*Armed Forces (Foreign); Certification; Laser Weapons; Targets*


**19980035026** Dassault Aviation, Istres,  France
**In-Flight Tests of the RAFALE** *Les Essais en Vol du RAFALE*
Castagnos, Patrick, Dassault Aviation, France; Tourtoulon, Marc, Centre d'Essais en Vol, France; Dec. 1997; 22p; In French; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche
The in-flight tests of the RAFALE presented the opportunity to face difficult challenges, to initiate new testing techniques, and to adopt new organizational approaches. Since 5 years have elapsed since the 1st flight of the RAFALE C01 and the 4 prototypes have logged over 2300 flights, it seemed appropriate to conduct a comparison between inflight tests as planned in 1990, and as they have in fact taken place up to the present. The two articles that follow undertake this analysis. The first is dedicated more specifically to the aspects of costs, general objectives of the program and the status of technical refinements. The second is more centered on state-industry relations and optimizing skills and resources.
Author
*In-Flight Monitoring; Costs; Industries*


**19980035027**  Westland Helicopters Ltd., Flight Test Dept., Yeovil,  UK
**The EH101 Development Programme**
Hazzard, Mark, Westland Helicopters Ltd., UK; Dec. 1997; 8p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche
This paper describes the EH101 helicopter flight development programme from initial conception to the present day. Lessons learned during the testing phase are highlighted and significant milestones achieved are detailed. In particular the early development testing is described in some detail.
Author
*Helicopters; In-Flight Monitoring; Flight Tests*


**19980035032**  Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Flight Mechanics, Brunswick,  Germany
**X-31A Tactical Utility Flight Testing**
Friehmelt, Holger, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Guetter, Richard, Daimler-Benz Aerospace A.G., Germany; Kim, Quirin, Bundesluftwaffe, Germany; Advances in Flight Testing; Dec. 1997; 10p; In English; Also announced as 19980035004; Sponsored in part by FMOD.; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche
The two X-31A were jointly built by Daimler-Benz Aerospace AG and Rockwell International. These German-American experimental aircraft were designed to explore the new realm of flight far beyond stall by employing advanced technologies like thrust vectoring and sophisticated flight control systems. The X-31A aircraft is equipped with a thrust vectoring system consisting of three aft mounted paddles to deflect the thrust vector in both pitch and yaw axes, thus providing the X-31A in this 'Enhanced Fighter Maneuverability program with an agility and maneuverability never seen before. The tactical utility of the X-31A using post stall technologies has been revealed in an extensive flight test campaign against various current state-of-the-art fighter aircraft in a close-in combat arena. The test philosophy included both simulation and flight test. The tremendous tactical advantage of the X-31A during the tactical utility evaluation flight test phase was accompanied by a deepened insight into post stall tactics its typical maneuvers, impacts on pilot-aircraft interfaces and requirements for future weapons to both engineers and the military

community. Some selected aspects of the tactical utility of the X-31A using post stall technologies unveiled by the International Test Organization are presented here.
Author
*Flight Tests; X-31 Aircraft; Thrust Vector Control; Design to Cost*

**19980035033** Eurofighter Jagdflugzeug G.m.b.H., Hallbergmoos, Germany
**The European Fighter Aircraft EF2000 Flight Test Programme Overview and Management Concept**
Herr, Michael, Eurofighter Jagdflugzeug G.m.b.H., Germany; Butcher, Paul, Eurofighter Jagdflugzeug G.m.b.H., Germany; Dec. 1997; 12p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche
The Eurofighter 2000 (EF2000) Flight Test programme began with first flight in 1994. The aircraft will enter service at the beginning of the next century. In addition to the challenge of basic certification of the airframe with many different Air-to-Air and Air-to-Ground stores configurations, Eurofighter Partner Companies are also conducting testing to fully integrate the new developed Radar (ECR90) and Engine (EJ200). This paper constitutes a description of the EUROFIGHTER Weapon System, the flight test programme management, an overview of the test programme plan and progress to date and discussion of unique challenges during testing. Up to now the EF2000 flight test programme has proceeded as planned and in-service certification should occur on schedule. The achievements reached so far can be attributed to a well designed and built aircraft, a comprehensive test plan, a very reliable data system, and the personal efforts of thousands of people in four different countries.
Author
*Fighter Aircraft; Flight Tests; Project Management*

**19980035034** Information Spectrum, Inc., Falls Church, VA USA
**The V-22 Osprey Integrated Test Team: A Perspective on Organizational Development and Teaming**
VanderVliet, Gery M., Information Spectrum, Inc., USA; Price, Robert C., Price (Robert C.), USA; Advances in Flight Testing; Dec. 1997; 8p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche
In February of 1993 the US Navy's V-22 Osprey Program Management Team established a new way of managing its flight test program. This newly established flight test organization would be a departure from what the Navy Test and Evaluation (T&E) community had been used to, especially for an Acquisition CATegory One (ACAT I) program. It was that February that the V-22 Osprey Program Manager (PMA) would sign into contract the establishment of the Navy's first Integrated Test Team (ITT). The V-22 ITT, following in the path of the Air Force Combined Test Force (CTF) concept, would encounter and overcome many challenges. Soon after the V-22 ITT would be established, the Navy's F-18E/F program would follow suit with its own ITT, validating the worthiness of such an organizational concept. This paper discusses the conception, development, benefits, challenges, and lessons learned associated with the setup and operation of the V-22 Osprey ITT. This paper is written as a perspective from government ITT management only.
Author
*V-22 Aircraft; Flight Tests; Management Methods; Management Planning*

**19980036880** Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Salisbury, Australia
**A Microprocessor-Based Gradient Analyser for F/A-18 Bulkhead Spectrum Loading**
Sponder, Leopold, Defence Science and Technology Organisation, Australia; Sep. 1997; 47p; In English
Report No.(s): AD-A335353; DSTO-TR-0546; DODA-AR-010-250; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report describes a specially designed instrument that was used during a full scale fatigue test of an F/A-18 bulkhead to support the acquisition and analysis of acoustic emission (AE) data for the investigation of crack initiation and growth. This device, developed by the author, comprises both hardware and software and generates binary data in real time that indicates the sign of the gradient of an applied spectrum load signal. This design overcomes the inherent limitations of conventional analog slope detection methods applied to slowly varying aperiodic waveforms.
DTIC
*Microprocessors; Real Time Operation; Binary Data; Acoustic Emission; Crack Propagation*

*Includes cockpit and cabin display devices; and flight instruments.*

**19980033532**  Naval Air Warfare Center, Weapons Div., China Lake, CA USA
**Modern Fighter Mission Avionics: The Joint Strike Fighter Avionics Architecture**
Lachenmaier, Ralph, Naval Air Warfare Center, USA; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 8p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The Joint Strike Fighter (JSF) program is potentially the largest new military aircraft program in the world today. A preliminary avionics architecture has been defined and published. Several efforts are underway to prototype and demonstrate various aspects of that architecture. The architecture will be refined and updated between now and the beginning of Engineering and Manufacturing Development (EMD) expected to begin in 2001. This paper describes the avionics architecture in its current state, discusses the motivation behind the various areas of the architecture, presents the issues involved, and discusses the results of some of the demonstration efforts. The JSF program is based on the four pillars: affordability, lethality, survivability, and supportability. First and foremost among the pillars is affordability. In order to field a lethal, supportable, survivable aircraft, affordability trade-offs will be conducted by the prime contractors. Historically, 30-40 percent of weapons system life cycle costs have been attributed to avionics, hence reduction in avionics systems costs are essential in satisfying JSF pillar requirements. An F-22 technology point-of-departure has been used to baseline the avionics architecture planning. The JSF is leveraging that significant technology investment, conducting maturation of new contributing technologies, and implementing, where appropriate, COTS components, standards, and processes to enhance affordability of the next generation strike fighter.
Derived from text
*Avionics; Fighter Aircraft; Product Development; Cost Reduction; Lethality; Military Aircraft*

**19980034341**

**Structural schemes of a specialized digital navigation device with fail-safe redundancy for aviation flight control and navigation systems** *Skhemy postroeniya spetsializirovannogo tsifrovogo navigatsionnogo ustrojstva odnokratnogo rezervirovaniya dlya aviatsionnykh pilotazhno-navigatsionnykh kompleksov*
Okoemov, B. N., Russia; Nikitin, S. E.; Petrov, V. M.; Seriya Priborostroenie; Dec. 1991; ISSN 0236-3933, no. 4, pp. 112-120; In Russian; Copyright; Avail: Aeroplus Dispatch

Various fail-safe redundancy schemes for the digital navigation devices of flight control and navigation systems are examined. The redundancy schemes considered are evaluated in terms of their contribution to the efficiency of the system with respect to the reliability criterion.
AIAA
*Digital Navigation; Air Navigation; Navigation Instruments; Design Analysis; Aircraft Control*

**19980035008**  Flight Test Squadron (40th), DOOB, Eglin AFB, FL USA
**AGM-130 Improved Modular Infrared Sensor (IMIRS) Flight Test**
Corej, Thomas A., Flight Test Squadron (40th), USA; Kosan, Keith J., Flight Test Squadron (40th), USA; Advances in Flight Testing; Dec. 1997; 8p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The AGM-130/Improved Modular Infrared Sensor (IMIRS) weapon system is operationally compatible with the F-15E and F-111F launch platforms. The addition of a rocket motor to the GBU-15, making it an AGM-130, increases the standoff range of the AGM-130. The IMIRS seeker is an InfraRed (IR) seeker for the AGM-130, and the AGM-130/IMIRS system provides sufficient resolution for target detection in day or night. Using a two-ship scenario (one weapon-carrying aircraft and one controlling aircraft), the controlling aircraft can stand off at an extended classified range and successfully guide the weapon to impact. The aimpoint update feature of the IMIRS seeker allows for small changes to be made in the aimpoint allowing for precisely attacking a specific point on a target. When the Weapon Systems Officer (WHO) locks-on to a target, he can slew to refine the Desired Mean Point of Impact (DMPI) and then lock-on to the new DMPI without breaking the lock on the original aimpoint.
Author
*Infrared Detectors; Flight Tests; Infrared Radiation; Target Acquisition*

**19980035016**  Royal Netherlands Air Force, Leeuwarden,  Netherlands
**A Data Acquisition System for the RNLAF MLU F-16 Requirements and Proposal**
Koolstra, H. J., Royal Netherlands Air Force, Netherlands; Hollestelle, P. M. N., National Aerospace Lab., Netherlands; Klijn,

J. M., National Aerospace Lab., Netherlands; Advances in Flight Testing; Dec. 1997; 6p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In 1983 the Royal Netherlands Air Force (RNLAF) requested the National Aerospace Laboratory NLR to design, procure and install a flight test data acquisition system to be used with the F-16 fighter aircraft. The design was heavily based on the systems, which were at that time nearing their completion for flight tests with Fokker aircraft. The system was delivered to the RNLAF in 1984 and has been continuously in use since that time. With the coming introduction of the Mid-Life Update programme of the F-16, it was foreseen that the current system would not be able to fulfill its tasks anymore. The RNLAF together with NLR draw up the requirements for a new data acquisition system. A proposal for the new system was made by NLR, again based on recent developments of flight test instrumentation for Fokker aircraft, but also with future developments in the field of airborne flight test instrumentation in mind. In this paper the requirements for the new system will be given. The proposed system will be described by means of a general concept. Although the final implementation of this general concept is not decided upon yet, the benefits and drawbacks of a possible implementation, based on the Common Airborne Instrumentation System standards, are discussed. It is concluded that there is a preference for this implementation, provided the tight time schedule can be met.
Author
*Data Acquisition; F-16 Aircraft; Flight Test Instruments; User Requirements; Airborne Equipment*


**19980035028**  Defence Evaluation Research Agency, Farnborough,  UK
**Tornado Integrated Avionics Research Aircraft (TIARA)**
Brown, A. D., Defence Evaluation Research Agency, UK; Stocks, A. J., Defence Evaluation Research Agency, UK; Dec. 1997; 10p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The paper describes the role, major features and flight trials programme of the Tornado Integrated Avionics Research Aircraft (TIARA). This significantly modified F2A(T) Tornado, ZD902, is the flagship of the trials fleet currently operated by the Defence Evaluation and Research Agency (DERA), an Executive Agency of the UK Ministry of Defence. TIARA is a multi-sensor, multi-role trials facility intended to demonstrate a "total systems integration" concept. It not only directly supports military customer programmes but also has sufficient capacity for collaborative programmes with other research organisations. Following a major conversion programme, ZD902 is now currently being used for the evaluation of IR sensors and helmet mounted displays. The future installation of the Blue Vixen Al radar will complete TIARA as a research facility and allow trials on sensor data fusion to begin.
Author
*Avionics; Flight Tests; Research Aircraft; MRCA Aircraft*


## 07
## AIRCRAFT PROPULSION AND POWER

*Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.*


**19980025034**

**Design and flight operation of powerplants**  *Ustrojstvo i letnaya ehkspluatatsiya silovykh ustanovok*
Solov'ev, Boris A., Russia; Kulandin, Arkadij A.; Makarov, Nikolaj V.; Rozhkov, I. A.; Shilimov, V. F.; 1991; In Russian; ISBN 5-277-01119-6; Copyright; Avail: Aeroplus Dispatch

The general design, principal components, and operation of powerplants are examined, with particular attention given to general structural schemes of gas-turbine engines, compressors, combustion chambers, gas turbines, inlet and exhaust devices, gear reducers and propellers, and the effect of operating conditions on the strength of the main components of gas-turbine engines. A combined analysis of the gasdynamic, thermal, and other processes taking place in gas-turbine engines at all flight stages is presented. The operation and maintenance aspects of powerplants are discussed with reference to flight efficiency, reliability and flight safety, powerplant monitoring during flight, troubleshooting, and operation under different climatic conditions.
AIAA
*Gas Turbine Engines; Turbocompressors; Combustion Chambers; Engine Inlets; Engine Design*


**19980031730**  NYMA, Inc., Brook Park, OH USA
**An Experiment on Losses in a Three-Port Wave Rotor**  *Final Report*
Wilson, Jack, NYMA, Inc., USA; Aug. 1997; 44p; In English
Contract(s)/Grant(s): NAS3-27186; RTOP 523-26-33

Wave rotors used in a gas turbine topping cycle, offer a potential route to higher specific power and lower specific fuel consumption. In order to exploit this potential properly, it is necessary to have some realistic means of calculating wave rotor performance, taking losses into account, so that wave rotors can be designed for good performance. This, in turn, requires a knowledge of the loss mechanisms. The experiment reported here was designed as a statistical experiment to identify the losses due to finite passage opening time, boundary layers, and leakage. On analyzing the data, incidence loss was also determined to be an important loss. For simplicity, the experiment used a three-port, flow divider, wave cycle, but the results are applicable to other cycles. A 12-in.-diameter rotor was used with two different lengths, 9 and 18 in., and two different passage widths, 0.25 and 0.54 in., in order to vary the boundary layer thicknesses and the opening time. to vary leakage, moveable end walls were provided so that the rotor to end-wall gap could be adjusted. The experiment is described and the results are presented together with a parametric fit to the data. The fit shows that there will be an optimum passage width for a given wave rotor since, as the passage width increases, boundary layer losses decrease, but opening-time losses increase and vice-versa. Leakage losses can be made small at reasonable gap sizes. Inlet ports should be designed to minimize incidence losses.
Author
*Gas Turbine Engines; Engine Design; Gas Turbines; Wave Rotors; Topping Cycle Engines; Losses*


**19980033528** General Electric Co., Aircraft Engines, Cincinnati, OH USA
**Balancing Affordability and Performance in Aircraft Engines**
Williams, J. C., General Electric Co., USA; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 6p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche
The historical measure of performance of an aircraft gas turbine engine has been simply the thrust it produces divided by its weight (T/W). While this measure is still appropriate, as the aircraft engine has matured, the rate of change of thrust to weight has begun to decrease and other factors such as costs have become increasingly important relative to performance. Therefore, it can be argued today that performance should have a broader, more comprehensive definition that includes other factors such as durability and reliability. Further, most modern military aircraft have some degree of "signature" treatment incorporated into the system. "Signature" is the radar (RF) or infrared (IR) signal that either emanates from or is created by an aircraft that allows its detection. The F-117 and B-2 systems are well known examples of low signature or "stealthy" systems. It is neither appropriate nor relevant to discuss signature control technology in detail here, but it is important to mention several points in connection with this subject. First, signature control is accomplished through a combination of the use of special design methods and materials with special physical properties. Second, any form of signature treatment adds weight and cost to the system. Third, the engine inlet and exhaust structures are a significant source of signature (both RF and IR) and require special attention if a given level is to be achieved. These areas of a system also represent the interface between the engine and the airframe and the responsibility for them typically is shared between the airframe and the engine manufacturers. Finally, retention of low signature usually requires additional maintenance and this also affects the affordability of a system.
Derived from text
*Aircraft Engines; Gas Turbine Engines; Balancing; Costs; Durability; Reliability*


**19980033529** Wright Lab., POTA, Wright-Patterson AFB, OH USA
**Reducing Costs for Aircraft Gas Turbine Engines**
Skira, Charles A., Wright Lab., USA; Philpot, Mike, Defence Research Agency, UK; Hauvette, Jacquesa, Societe Nationale d'Etudes et de Construction de Moteurs Aeronautiques, France; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 10p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche
Current military budget constraints are highlighting the cost issues in procuring and maintaining adequate defense forces. Aircraft and their engines are typical examples where costs are more and more expensive from one generation to the other. However, at the same time, it is recognized that the correlated increase in performance is necessary to keep the pace with the potential of adverse weaponry. Due to the historic and dramatic changes in recent global events, the USA military services have been undergoing a drawdown in size. Since 1989, our military forces have been reduced by 30%. Over this period of declining budgets the DoD has slowed down the modernization of our forces in order to concentrate on maintaining force readiness and quality of life. However, by the year 2010, more than half of the US Air Force fighter fleet will consist of existing F-15's, F-16's and F-117A's, well beyond the expected service life of these systems. DoD and other defense departments must address the modernization of their forces to ensure readiness into the next century. This modernization will only be possible within the era of reduced defense

budgets when the S&T community begins to focus on increasing the effectiveness of a user-identified capability while decreasing the costs of the necessary technology, and improving material through planned upgrades.
Derived from text
*Aircraft Engines; Gas Turbine Engines; Cost Reduction; Service Life*


**19980035010**  Alenia Aeronautica, Alenia Flight Test, Turin,  Italy
**Alenia Approach to EF2000 Propulsion System Flight Test: Methodology and Test Results**
Bellero, Lucio, Alenia Aeronautica, Italy; Dogliatti, Francesco, Alenia Aeronautica, Italy; Girolami, Claudio, Alenia Aeronautica, Italy; Dec. 1997; 12p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

EUROFIGHTER 2000 is a single seat, aerodynamically unstable delta-canard fighter aircraft which embodies latest technologies in structures, systems, engine and avionics. The aircraft is powered by two EJ 200, a new engine specifically tailored to meet EF2000 mission requirements. Eurofighter Jagdflugzeug GmbH consortium is the prime contractor for the development of the complete weapon system. It is composed of the four national aircraft companies involved in the program, namely British Aerospace (BAe), Daimler-Benz Aerospace (DASA), Alenia (ALN) and CASA . Within this program, Alenia is tasked (among the other responsibilities) with the propulsion system development, that has been initially flight-tested by Alenia prototype DA3; it has been the first one fitted with the new EJ200 engines (built by Eurojet consortium). DA7, the second Alenia prototype, will be tasked (among other tasks like avionics/navigation testing) of final aircraft/engines performance verification. The first phase of the development programme has been successfully completed and the following phase, with the uprated engines standard, is already in progress. This paper summarizes: (1) the overall EF2000 flight test philosophy; (2) the approach to EJ200 engine flight test, including relight; (3) test organization, test methods, flight test instrumentation, data analysis, data management and (4) early test results.
Author
*Propulsion; Flight Test Instruments; Fighter Aircraft; Engine Tests*


**19980035011**  Centre d'Essais en Vol, Base d'Essais d'Istres, Istres,  France
**Flight Ticket M 88-2**  *Bon de Vol M 88-2*
Nicolet, Eric, Centre d'Essais en Vol, France; Dec. 1997; 10p; In French; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The M88-2 is the engine installed in the multi-purpose fighter Rafale. The in-flight qualification method of the regulation consists of having a representative engine of the worst engine mass produced and to verify that its performance is sound, within all aspects of flight.
Author
*Fighter Aircraft; Engine Noise; Performance Tests*


# 08
# AIRCRAFT STABILITY AND CONTROL

*Includes aircraft handling qualities; piloting; flight controls; and autopilots.*


**19980024956**

**On-line identifications for modal parameters of missile body with disturbed attitude error angle output**
Feng, Youtian, Harbin Inst. of Technology, China; Li, Yuntang, Harbin Inst. of Technology, China; Deng, Zhidong, Harbin Inst. of Technology, China; Hu, Hengzhang, Harbin Inst. of Technology, China; 1991, pp. 78-84; In English; Copyright; Avail: Aeroplus Dispatch

A modified Ibrahim time domain method is developed for elastic vibration problems with one practical measuring station. The method uses the Butterworth digital profiler, the RQI algorithm, and the complex Jacobi method to improve the accuracy and speed of modal parameter identification. Comparison of theoretical results with numerical ones shows that the method is reliable and provides the required accuracy.
AIAA
*On-Line Systems; System Identification; Missile Systems; Attitude Control; Error Analysis*

**19980025559**  Moscow Inst. of Aviation Technology, Pilot-Vehicle Lab., USSR
**Development of Criteria For Prediction of Handling Qualities of New Generation of Aircraft** *Final Report*
Efremov, Alexander, Moscow Inst. of Aviation Technology, USSR; Nov. 1997; 167p; In English
Contract(s)/Grant(s): F61708-96-W-0275
Report No.(s): AD-A333344; EOARD-SPC-96-4073; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
    This report results from a contract tasking Moscow Aviation Institute (MAI) as follows: Discuss the context of the problem in standardization of flying qualities and formulate the system approach for its solution.
DTIC
*Controllability; Flight Characteristics*


**19980027605**  NASA Ames Research Center, Moffett Field, CA USA
**Optimization of Supersonic Transport Trajectories**
Ardema, Mark D., Santa Clara Univ., USA; Windhorst, Robert, Santa Clara Univ., USA; Phillips, James, NASA Ames Research Center, USA; Mar. 1998; 58p; In English
Contract(s)/Grant(s): RTOP 522-41-42
Report No.(s): NASA/TM-1998-112223; NAS 1.15:112223; A-98-09997; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
    This paper develops a near-optimal guidance law for generating minimum fuel, time, or cost fixed-range trajectories for supersonic transport aircraft. The approach uses a choice of new state variables along with singular perturbation techniques to time-scale decouple the dynamic equations into multiple equations of single order (second order for the fast dynamics). Application of the maximum principle to each of the decoupled equations, as opposed to application to the original coupled equations, avoids the two point boundary value problem and transforms the problem from one of a functional optimization to one of multiple function optimizations. It is shown that such an approach produces well known aircraft performance results such as minimizing the Brequet factor for minimum fuel consumption and the energy climb path. Furthermore, the new state variables produce a consistent calculation of flight path angle along the trajectory, eliminating one of the deficiencies in the traditional energy state approximation. In addition, jumps in the energy climb path are smoothed out by integration of the original dynamic equations at constant load factor. Numerical results performed for a supersonic transport design show that a pushover dive followed by a pull-out at nominal load factors are sufficient maneuvers to smooth the jump.
Author
*Supersonic Transports; Trajectory Optimization; Transport Aircraft*


**19980028446**  NASA Dryden Flight Research Center, Edwards, CA USA
**Wavelet Filtering to Reduce Conservatism in Aeroservoelastic Robust Stability Margins**
Brenner, Marty, NASA Dryden Flight Research Center, USA; Lind, Rick, NASA Dryden Flight Research Center, USA; Mar. 1998; 16p; In English; Structures, Structural Dynamics and Materials Conference, 20-23 Apr. 1998, Long Beach, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 529-50-04
Report No.(s): NASA/TM-1998-206545; NAS 1.15:206545; H-2222; AIAA Paper 98-1896; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
    Wavelet analysis for filtering and system identification was used to improve the estimation of aeroservoelastic stability margins. The conservatism of the robust stability margins was reduced with parametric and nonparametric time-frequency analysis of flight data in the model validation process. Nonparametric wavelet processing of data was used to reduce the effects of external desirableness and unmodeled dynamics. Parametric estimates of modal stability were also extracted using the wavelet transform. Computation of robust stability margins for stability boundary prediction depends on uncertainty descriptions derived from the data for model validation. F-18 high Alpha Research Vehicle aeroservoelastic flight test data demonstrated improved robust stability prediction by extension of the stability boundary beyond the flight regime.
Author
*Wavelet Analysis; Aeroservoelasticity; Transfer Functions*


**19980028448**  Lockheed Martin Corp., Hampton, VA USA
**Implementation and Testing of Turbulence Models for the F18-HARV Simulation**
Yeager, Jessie C., Lockheed Martin Corp., USA; Mar. 1998; 146p; In English
Contract(s)/Grant(s): NAS1-96014; RTOP 522-35-11-03
Report No.(s): NASA/CR-1998-206937; NAS 1.26:206937; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report presents three methods of implementing the Dryden power spectral density model for atmospheric turbulence. Included are the equations which define the three methods and computer source code written in Advanced Continuous Simulation Language to implement the equations. Time-history plots and sample statistics of simulated turbulence results from executing the code in a test program are also presented. Power spectral densities were computed for sample sequences of turbulence and are plotted for comparison with the Dryden spectra. The three model implementations were installed in a nonlinear six-degree-of-freedom simulation of the High Alpha Research Vehicle airplane. Aircraft simulation responses to turbulence generated with the three implementations are presented as plots.
Author
*Turbulence Models; Atmospheric Turbulence; Atmospheric Models; Flight Characteristics; Aircraft Performance*

**19980030366**
**Design of active flutter suppression control systems using mu synthesis and controller reduction**
Fujimori, A., Shizuoka Univ., Japan; Nikiforuk, P. N.; Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering; 1997; ISSN 0954-4100; Volume 211, no. 3, pp. 183-192; In English; Copyright; Avail: Issuing Activity
This paper presents a control synthesis o a two-dimensional aerofoil active flutter suppression (2D-AFS) using mu synthesis and the extended coprime factorization (weighted) (ECFW) controller reduction method in numerical simulation. A multiplicative uncertainty representation is chosen as a structured uncertainty model of the 2D-AFS system because H infinity norm of the uncertainty due to changes in the flight velocity is calculated small by using the multiplicative uncertainty representation. Controllers are designed by mu synthesis in the frame of the robust stability and the robust control performance problems. Furthermore, using the ECFW controller reduction method, a seventh-order controller whose performances are almost the same as those of the original controller is obtained.
Author (EI)
*Active Control; Vibration Damping; Flutter; Control Systems Design; Control Equipment; Systems Stability; Robustness (Mathematics)*

**19980031520** California Univ., Dept. of Mechanical and Aeronautical Engineering, Davis, CA USA
**A Theory for the Roll-Ratchet Phenomenon in High Performance Aircraft**
Hess, Ronald A., California Univ., USA; 1997; 10p; In English
Contract(s)/Grant(s): NAG1-1744
Report No.(s): NASA/CR-97-207289; NAS 1.26:207289; AIAA Paper 97-3498; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Roll-ratchet refers to a high frequency oscillation which can occur in pilot-in-the-loop control of roll attitude in high performance aircraft. The frequencies of oscillation are typically well beyond those associated with the more familiar pilot-induced oscillation. A structural model of the human pilot which has been employed to provide a unified theory for aircraft handling qualities and pilot-induced oscillations is employed here to provide a theory for the existence of roll-ratchet. It is hypothesized and demonstrated using the structural model that the pilot's inappropriate use of vestibular acceleration feedback can cause this phenomenon, a possibility which has been discussed previously by other researchers. The possible influence of biodynamic feedback on roll ratchet is also discussed.
Author
*Aircraft Control; Attitude (Inclination); Roll; Pilot Induced Oscillation; Feedback; Controllability*

**19980034888**
**Applications of a quasi-stationary autopilot in a nonstationary aircraft-autopilot system** *Oblasti primeneniya kvazistatsionarnogo avtopilota v nestatsionarnoj sisteme samolet-avtopilot*
Okoemov, B. N., Russia; Nikitin, S. E.; Petrov, V. M.; Seriya Priborostroenie; Dec. 1991; ISSN 0236-3933, no. 4, pp. 120-126; In Russian; Copyright; Avail: Aeroplus Dispatch
A method for estimating the stationarity of autopilot parameters is proposed which is based on the sensitivity theory. Calculations of the final approach of an aircraft using the signals of angle-measuring radio instruments are presented as an example.
AIAA
*Automatic Pilots; Man Machine Systems; Aircraft Landing; Radio Navigation; Aircraft Control*

**19980035029** Daimler-Benz Aerospace A.G., Military Aircraft Div., Manching, Germany

**Investigations on Handling Qualities and Aerodynamic Characteristics of EUROFIGHTER 2000 at DAIMLER-BENZ AEROSPACE Flight Test Centre**

Oelker, Hans-Christoph, Daimler-Benz Aerospace A.G., Germany; Muthsam, Erfried W., Daimler-Benz Aerospace A.G., Germany; Dec. 1997; 12p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Currently the development flight test evaluation of EUROFIGHTER 2000 is under way. The present paper emphasizes on analysis methods for flight mechanical and aerodynamical evaluation suitable for a very agile, highly unstable fighter aircraft at DAIMLER-BENZ AEROSPACE flight test centre. Methods are summarized and illustrated with some representative results. Analysis methods in the time domain such as simulation of flown manoevres and in the frequency domain such as Z-transformation and Fourier analysis methods for system stability evaluations are presented. DASA's aerodynamic parameter identification method is presented. It resembles a unique equation decoupling approach to cope with the problems arising from the analysis of unstable aircraft. Representative results are given, which demonstrate the analysis capabilities of the presented methods.
Author
*Qualitative Analysis; Aerodynamic Characteristics; Flight Tests; Fighter Aircraft*


**19980035030** Daimler-Benz Aerospace A.G., Flight Guidance and Control, Hamburg, Germany

**Flight Testing of Manual Flight Control Functions for a Small Transport Aircraft (Project ATTAS-SAFIR)**

Heintsch, Thomas, Daimler-Benz Aerospace A.G., Germany; Luckner, Robert, Daimler-Benz Aerospace A.G., Germany; Hahn, Klaus-Uwe, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Dec. 1997; 10p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In a technology programme DASA has developed Flight Control Laws (FCL) for an electronic flight control system of a small transport aircraft (100-seater). In a cooperation between DASA and DLR, the flight control functions were tested on DLR's VFW614/ATTAS test aircraft. This paper gives an overview of the flight control law development and testing within the SAFIR (Small Airliner Flight Control Law Investigation and Refinement) flight test project. Design objectives of the flight control system for the 100-seater are reviewed, a system overview is given, the flight control law functions are briefly explained and the development process is described. The testing procedure comprises the Small Airliner Flight Investigation and Refinement (SAFIR) experiment integration into the ATTAS test system, the definition of the flight tasks, the flight testing and the evaluation of the flight test results.
Author
*Flight Tests; Electronic Control; Transport Aircraft*


**19980035031** NASA Dryden Flight Research Center, Edwards, CA USA

**Evaluation of High-Angle-of-Attack Handling Qualities for the X-31A Using Standard Evaluation Maneuvers**

Stoliker, Patrick C., NASA Dryden Flight Research Center, USA; Bosworth, John T., NASA Dryden Flight Research Center, USA; Dec. 1997; 24p; In English; Also announced as 19980035004; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The X-31A aircraft gross-acquisition and fine-tracking handling qualities have been evaluated using standard evaluation maneuvers developed by Wright Laboratory, Wright Patterson Air Force Base. The emphasis of the testing is in the angle-of-attack range between 30 deg. and 70 deg. Longitudinal gross-acquisition handling qualities results show borderline Level l/Level 2 performance. Lateral gross-acquisition testing results in Level l/Level 2 ratings below 45 deg. angle of attack, degrading into Level 3 as angle of attack increases. The fine tracking performance in both longitudinal and lateral axes also receives Level 1 ratings near 30 deg. angle of attack, with the ratings tending towards Level 3 at angles of attack greater than 50 deg. These ratings do not match the expectations from the extensive close-in combat testing where the X-31A aircraft demonstrated fair to good handling qualities maneuvering for high angles of attack. This paper presents the results of the high-angle-of-attack handling qualities flight testing of the X-31A aircraft. Discussion of the preparation for the maneuvers, the pilot ratings, and selected pilot comments are included. Evaluation of the results is made in conjunction with existing Neal Smith, bandwidth, Smith-Geddes, and military specifications.
Author
*Evaluation; Angle of Attack; X-31 Aircraft; Flight Tests; Q Factors*


**19980036976** NASA Dryden Flight Research Center, Edwards, CA USA

**Worst-Case Flutter Margins from F/A-18 Aircraft Aeroelastic Data**

Lind, Rick, NASA Dryden Flight Research Center, USA; Brenner, Marty, NASA Dryden Flight Research Center, USA; Apr.

1997; 11p; In English; Structures, Structural Dynamics and Materials Conference, Apr. 1997, Orlando, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA/TM-97-207564; NAS 1.15:207564; AIAA Paper 97-1266; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An approach for computing worst-case flutter margins has been formulated in a robust stability framework. Uncertainty operators are included with a linear model to describe modeling errors and flight variations. The structured singular value, micron, computes a stability margin which directly accounts for these uncertainties. This approach introduces a new method of computing flutter margins and an associated new parameter for describing these margins. The micron margins are robust margins which indicate worst-case stability estimates with respect to the defined uncertainty. Worst-case flutter margins are computed for the F/A-18 SRA using uncertainty sets generated by flight data analysis. The robust margins demonstrate flight conditions for flutter may lie closer to the flight envelope than previously estimated by p-k analysis.

Author

*Flutter; Aeroelasticity; Models; Unsteady Aerodynamics; Fourier Analysis*


# 09
# RESEARCH AND SUPPORT FACILITIES (AIR)

*Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.*


19980023494  NASA Langley Research Center, Hampton, VA USA

**Technical Assessment of the National Full Scale Aerodynamic Complex Fan Blades Repair**

Young, Clarence P., Jr., Vigyan Research Associates, Inc., USA; Dixon, Peter G., Advanced Technologies, Inc., USA; St.Clair, Terry L., NASA Langley Research Center, USA; Johns, William E., Washington State Univ., USA; Jan. 1998; 44p; In English

Contract(s)/Grant(s): RTOP 282-10-01-01

Report No.(s): NASA/TM-1998-206932; NAS 1.15:206932; L-17701; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the principal activities of a technical review team formed to address National Full Scale Aerodynamic Complex (NFAC) blade repair problems. In particular, the problem of lack of good adhesive bonding of the composite overwrap to the Hyduliginum wood blade material was studied extensively. Description of action plans and technical elements of the plans are provided. Results of experiments designed to optimize the bonding process and bonding strengths obtained on a full scale blade using a two-step cure process with adhesive primers are presented. Consensus recommendations developed by the review team in conjunction with the NASA Ames Fan Blade Repair Project Team are provided along with lessons learned on this program. Implementation of recommendations resulted in achieving good adhesive bonds between the composite materials and wooden blades, thereby providing assurance that the repaired fan blades will meet or exceed operational life requirements.

Author

*Fan Blades; Adhesive Bonding; Composite Wrapping; Wind Tunnels*


19980030172

**Dynamic expansion and location of an airport: A multiple objective approach**

Min, Hokey, Auburn Univ., USA; Melachrinoudis, Emanuel; Wu, Xing; Transportation Research, Part A: Policy and Practice; September, 1997; ISSN 0965-8564; Volume 31, no. 5, pp. 403-417; In English; Copyright; Avail: Issuing Activity

In this paper we propose a dynamic, multi-objective, mixed integer programming model that aims to determine the optimal airport site under capacity and budgetary restrictions. In contrast with the existing models, the proposed model can also solve a practical size location-allocation problem without serious computational difficulty. As a practical example, the model has been applied to the airport expansion and construction problem facing the Massachusetts Port Authority and Aeronautics Commission.

Author (EI)

*Position (Location); Airports; Dynamic Programming; Mathematical Models; Problem Solving*


19980031728  NASA Lewis Research Center, ClevelandOH USA

**Design and Checkout of a High Speed Research Nozzle Evaluation Rig**

Castner, Raymond S., NASA Lewis Research Center, USA; Wolter, John D., NASA Lewis Research Center, USA; Oct. 1997; 15p; In English; 36th; Aerospace Sciences Meeting and Exhibit, 12-15 Jan. 1998, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

The High Flow Jet Exit Rig (HFJER) was designed to provide simulated mixed flow turbojet engine exhaust for one-seventh scale models of advanced High Speed Research test nozzles. The new rig was designed to be used at NASA Lewis Research Center in the Nozzle Acoustic Test Rig and the 8 x 6 Supersonic Wind Tunnel. Capabilities were also designed to collect nozzle thrust measurement, aerodynamic measurements, and acoustic measurements when installed at the Nozzle Acoustic Test Rig. Simulated engine exhaust can be supplied from a high pressure air source at 33 pounds of air per second at 530 degrees Rankine and nozzle pressure ratios of 4.0. In addition, a combustion unit was designed from a J-58 aircraft engine burner to provide 20 pounds of air per second at 2000 degrees Rankine, also at nozzle pressure ratios of 4.0. These airflow capacities were designed to test High Speed Research nozzles with exhaust areas from eighteen square inches to twenty-two square inches. Nozzle inlet flow measurement is available through pressure and temperature sensors installed in the rig. Research instrumentation on High Speed Research nozzles is available with a maximum of 200 individual pressure and 100 individual temperature measurements. Checkout testing was performed in May 1997 with a 22 square inch ASME long radius flow nozzle. Checkout test results will be summarized and compared to the stated design goals.
Author
*Nozzle Flow; Rigging; Exhaust Flow Simulation; Exhaust Nozzles; Multiphase Flow; Flow Measurement; Aircraft Engines; Turbojet Engines; Air Flow; Fixtures; Design Analysis*


**19980033520** Wright Lab., FII, Wright-Patterson AFB, OH USA
**The Use of Technology Demonstrators to Reduce System Acquisition Cost**
Moorhouse, David J., Wright Lab., USA; Paul, Donald B., Wright Lab., USA; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 12p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In the definition and design of a new aircraft system, the choice of technologies to be incorporated is a major decision. Although the latest technology usually yields the maximum (predicted) performance, the readiness of each technology must be carefully assessed. The less the readiness or maturity, the greater the risk to development schedule and cost. There is a premium therefore, on demonstrations that validate the appropriate maturity of each technology. For some things ground demonstration is adequate to reduce the risk to an acceptable level. Some technologies, on the other hand, can only be validated through flight demonstration. Technology flight demonstration programs have been accomplished in many forms, explicit prototype vehicles, the X-plane series from the X-1 to the X-31 and technology demonstrations with an explicit military objective.
Derived from text
*Aircraft Design; Flight Tests; Cost Reduction; Prototypes; Costs*


**19980034683** Naval Postgraduate School, Monterey, CA USA
**A Methodology For Improving the Usability of the ANVIS/HUD Computer Based Trainer**
Rozelle, Daniel R., Naval Postgraduate School, USA; Mar. 1997; 108p; In English
Report No.(s): AD-A333324; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Computer software has taken an increasingly larger role in the U.S. Navy. It is used in nearly every facet of naval operations, from administrative chores to controlling complex weapons systems. Because of the high cost of software and the potential for inadvertent misuse, it is important that software be easy to use and understand. This thesis explores the methods and techniques available for conducting software usability evaluations. Using one of the methods described in this thesis, actual software usability testing is done on a recently developed computer-based training (CBT) program. The CBT program evaluated in this study is designed to instruct helicopter pilots in the use of the AN/AVS-7 ANVIS/HUD. The device is an advanced night vision goggle system that is comprised of the AN/AVS-6 ANVIS night vision goggle (NVG) set and a Heads-Up Display (HUD). This thesis describes the usability test conducted on the ANVIS/HUD CBT and establishes a methodology that can be used, not only on future versions of the ANVIS/HUD CBT, but on other PC oriented software. The result of this usability test show that improvement can be made to the navigation method used by the CBT and the presentation of instructional material.
DTIC
*Complex Systems; Computer Programs; Computer Techniques; Head-Up Displays; Night Vision; Program Verification (Computers); Training Devices*

*Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.*

**19980024558**

**A new synthesizing method in designing the control system of carrier-rockets**

Li, Jingci, Beijing Aerospace Automatic Control Inst., China; 1991, pp. 102-105; In English; Copyright; Avail: Aeroplus Dispatch

A new scheme to design flight control systems for carrier rockets is presented. A simulation is used to show that the system is feasible and practical.

AIAA

*Rocket Flight; Control Systems Design; Systems Simulation; Feedback Control; Flight Control*

**19980029679** George Washington Univ., Joint Inst. for Advancement of Flight Sciences, Hampton, VA USA

**Magellan Aerodynamic Characteristics During the Termination Experiment Including Thruster Plume-Free Stream Interaction**

Cestero, Francisco J., George Washington Univ., USA; Tolson, Robert H., George Washington Univ., USA; Mar. 1998; 117p; In English

Contract(s)/Grant(s): NCC1-104; RTOP 242-80-01-01

Report No.(s): NASA/CR-1998-206940; NAS 1.26:206940; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Results are presented on the aerodynamic characteristics of the Magellan spacecraft during the October 1994 Termination Experiment, including the effects of the thruster engine exhaust plumes upon the molecular free stream around the spacecraft and upon the aerodynamics coefficients. As Magellan passed through the Venusian atmosphere, the solar arrays were turned in opposite directions relative to the free stream creating a torque on the spacecraft. The spacecraft control system was programmed to counter the effects of this torque with attitude control engines to maintain an inertially fixed attitude. The orientation and reaction engine telemetry returned from Magellan are used to create a model of the aerodynamic torques. Geometric models of the Magellan spacecraft are analyzed with the aid of both free molecular and Direct Simulation Monte Carlo codes. The simulated aerodynamic torques determined are compared to the measured torques. The Direct Simulation Monte Carlo method is also used to model the attitude engine exhaust plumes, the free stream disturbance caused by these plumes, and the resulting torques acting on the spacecraft compared to no-exhaust plume cases. The effect of the exhaust plumes was found to be sufficiently large that thrust reversal is possible.

Author

*Magellan Spacecraft (NASA); Aerodynamic Characteristics; Turbulent Flow; Exhaust Gases; Thrust Reversal; Free Flow; Plumes*

**19980036925** National Space Development Agency, Office of Space Transportation Systems, Tokyo, Japan

**Wind Tunnel Testing for Spaceplane Development**

Hozumi, Kohichi, National Aerospace Lab., Japan; Akimoti, Toshio, National Space Development Agency, Japan; Katsurahara, Tadashi, Mitsubishi Heavy Industries Ltd., Japan; Design Engineering; Dec. 1997; Volume 30, No. 9; 30p; In English; Translated into English by NASDA

Report No.(s): NASDA-ETR-970009; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche; US Sales Only; US Sales Only

In Japan, the National Space Development Agency and National Aerospace Laboratory take the initiative in studying the development of a spaceplane named HOPE (standing for H-II Orbiting Plane) which they aim to fly sometime between the late 1990s and early 2000s. The HOPE is an unmanned winged spaceplane to be launched by an H-II rocket or an enhanced H-II evolution type rocket; its major tasks are transporting supplies to and recovering space stations in earth orbits. It is a reusable airframe that, after finishing these tasks, reenters the atmosphere, glides in and lands at a ground landing site like an airplane. The HOPE is mounted at the tip of an H-II rocket and launched; after completing its tasks in orbit, it reenters the atmosphere and ultimately lands on a runway by gliding like an ordinary airplane. For this reason, an airframe must be embodied that meets various design requirements corresponding to these flight phases. In addition, the conventional airplane development approach in which the flight domain is enlarged step-by-step by confirming the airplane's performance through preliminary flight tests cannot be applied to the HOPE; instead, it is required to exclude as many uncertain elements related to flight as possible at the development stage or to construct an autopilot system in anticipation of these elements. The flight domain extends from the ground to space, and the

flight velocity covers a wide range from a hypersonic velocity immediately after the reentry into the atmosphere, reaching about Mach 30, to subsonic velocities. Experience of developing a hypersonic winged airplane is virtually nonexistent in Japan. The precision of estimating aerodynamic characteristics and aerodynamic heating characteristics of an actual spaceplane affects the integrity of an airframe system; therefore, the research and development activities have been focused on this area. In the present paper, the authors specifically describe the roles that wind tunnel testing plays in developing a spaceplane and the progress of designing a spaceplane, including aspects of computational fluid dynamics (CFD) and flight experiments and enumeration of technological problems to be addressed in the future.
Author
*Wind Tunnel Tests; Aerodynamic Characteristics; Temperature Effects; Computational Fluid Dynamics; Automatic Pilots*

# 11
# CHEMISTRY AND MATERIALS

*Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.*

**19980024244** Illinois Univ. at Urbana-Champaign, Urbana, IL USA
**Materials Degradation and Fatigue Under Extreme Conditions** *Final Report, 1 Apr. 1994 - 31 Aug. 1997*
Jonas, Jiri, Illinois Univ. at Urbana-Champaign, USA; Oct. 29, 1997; 93p; In English
Contract(s)/Grant(s): F49620-93-I-0241; AF Proj. 3484
Report No.(s): AD-A334785; AFRL-SR-BL-TR-98-0061; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
     This AFOSR URI addressed complex research problems of materials degradation and fatigue in aerospace structures in severe or extreme environments. A better understanding of materials degradation and flaw initiation dynamics was achieved through a multi-disciplinary research program encompassing chemistry, surface physics, materials science and mechanics, both experimental and theoretical. The Subprojects were as follows: (1) Surface Induced Degradation of Fluorocarbon Lubricants; (2) Molecular Tribology of Perfluoroether Lubricants; (3) Fluids, Including Lubricants Under Extreme Conditions of High Pressure/High Temperature and Confinement; (4) Surface Crack Propagation Under Combined Mechanical and High Pressure Fluid Loading; and (5) Lubricant Assisted Fatigue Crack Growth in Ceramics.
DTIC
*Aircraft Structures; Fatigue (Materials); Multidisciplinary Research; Crack Propagation*

**19980025244**

**Comparison of the effects of storage in the presence of copper using laboratory vs field conditions on jet fuel thermal stability as measured by the gravimetric JFTOT**
Pande, Seetar G., Geo-Cent., Inc., USA; Hardy, Dennis R.; Energy & Fuels; September-October, 1997; ISSN 0887-0624; Volume 11, no. 5, pp. 1019-1025; In English; Copyright; Avail: Issuing Activity
     The effects of storage in the presence of copper using laboratory test conditions vs field conditions on fuel thermal stability were compared using five JP-5 fuels. Laboratory test conditions refer to accelerated storage at 90 C/50 psig of air/24 h in the presence of soluble copper from copper(II) ethyl acetoacetate (CuEA). In contrast, field conditions refer to long-term storage at room temperature (approximately 20 C) in the presence of dissolved copper from 90/10 copper-nickel (Cu-Ni) alloy for a period of approximately 6 months. Thermal stabilities were determined using the gravimetric JFTOT, which gives a quantitative measure of the total deposits formed. A copper concentration/storage effect was observed, which necessitated evaluations at similar copper concentrations. However, the source of copper appears not to be important. Instead, the main operative factor affecting the thermal stability of stored fuels appears to be the combination of long-term ambient storage and the presence of copper. Good agreement was obtained between the thermal stabilities of fuels that were stored using the specified laboratory and field conditions. These results are significant because (1) they validate the use of the specified laboratory test conditions as being realistic; (2) they support our premise that precursors that lead to thermal deposits are formed on storage in the presence of copper; and (3) they offer a rigorous method for predicting the potential thermal stabilities of jet fuels.
Author (EI)
*Ethyl Compounds; Jet Engine Fuels; Thermal Stability; Aircraft Fuels; Copper; Composition (Property); Fuel Tanks*

**19980029852**

**Durability of aluminium-sealant joints in jet-fuel, water and antifreeze**

Comyn, J., De Montfort Univ., UK; Day, J.; Shaw, S. J.; International Journal of Adhesion and Adhesives; August, 1997; ISSN 0143-7496; Volume 17, no. 3, pp. 213-221; In English; Copyright; Avail: Issuing Activity

The durability has been studied of aluminum-sealant joints immersed in jet-fuel, water and antifreeze. The sealants were a polysulfide, a fluorosilicone and a silicone, and durability was primarily controlled by the amount of fluid absorbed by the sealants. This gives polysulfide joints in antifreeze and silicone joints in jet-fuel very poor durability. The performance of polysulfide-aluminum joints was not significantly improved by treatment of the metal with silane coupling agents or phosphoric acid anodisation. Joints with the fluorosilicone sealant were durable in all the fluids.

Author (EI)

*Destructive Tests; Jet Engine Fuels; Metal Joints; Phosphoric Acid; Adhesive Bonding; Bonded Joints; Durability; Aluminum; Water; Aluminum Alloys*


**19980036516**

**Fatigue, creep and creep/fatigue behaviour of a nickel base superalloy at 700 C**

Hyde, T. H., Univ. of Nottingham, UK; Xia, L.; Becker, A. A.; Sun, W.; Fatigue and Fracture of Engineering Materials & Structures; 1997; ISSN 8756-758X; Volume 20, no. 9, pp. 1295-1303; In English; Copyright; Avail: Issuing Activity

This paper presents the results of an experimental testing programme to examine the uniaxial creep, low cycle fatigue and creep/fatigue interaction behavior of a Ni-base superalloy at 700 C. The material is used in the manufacture of aeroengine turbine discs. A creep continuum damage mechanics model is shown to be capable of accurately predicting the creep and creep rupture behavior of the material. A healing term has been incorporated into the damage mechanics model to allow the behavior under creep/fatigue conditions to be described.

Author (EI)

*Aircraft Engines; Creep Properties; Heat Resistant Alloys; Nickel Alloys; Nickel; Fatigue (Materials); Creep Tests; High Temperature; Temperature Effects*


# 12
# ENGINEERING

*Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.*


**19980024397**

**Improved technique for blade radius measurement**

Nielsen, Michael, TSI Inc.; Osmondson, Brian; Wipfler, Thomas; Turbomachinery International; September-October, 1997; ISSN 0149-4147; Volume 38, no. 5, pp. 51-52, 54; In English; Copyright; Avail: Issuing Activity

A new optical measurement technique, called the Radius Tracer Model RT 100, was developed to provide fast, accurate blade radius measurements for turbine aircraft engines and for land-based gas and steam turbines. Radius measurements can be obtained with one micrometer resolution, while rotating at speeds up to 12,000 rpm. The system is capable of determining the radii without concern for tip reflectivity and does not need to be calibrated for each blade type. Also, the RT 100 system measures on every blade, providing radius data very quickly for real-time grinding purposes.

EI

*Compressor Blades; Measuring Instruments; Compressors; Turbomachine Blades; Optical Equipment; Imaging Techniques*


**19980024463**

**GPS innovator genset brings T-53 down to earth**

Barker, Thomas; Turbomachinery International; September-October, 1997; ISSN 0149-4147; Volume 38, no. 5, pp. 22; In English; Copyright; Avail: Issuing Activity

Gas Power Systems (GPS) has introduced the Innovator Genset, a 1- to 1.2-MW power generation package based on rebuilt Lycoming T-53 gas turbine with a unique control system. The genset features many accessories which are driven by electric motors

or off of the gearbox, for greater reliability. It processes large amount of information at high speed, giving the operator real-time information and trending.

EI

*Global Positioning System; Helicopter Engines; Gas Turbines; Electric Generators; Electric Power Supplies; Aircraft Engines*


**19980025566**  Army Research Lab., Weapons and Materials Research Directorate, Aberdeen Proving Ground, MD USA

**3-D Parachute Descent Analysis Using Coupled Computational Fluid Dynamic and Structural Codes**  *Final Report*

Sahu, Jabaraj, Army Research Lab., USA; Cooper, Gene R., Army Research Lab., USA; Benney, Richard J., Natick Research, Development and Engineering Center, USA; Sep. 1997; 28p; In English

Contract(s)/Grant(s): DA Proj. 1L1-61102-AH-43

Report No.(s): ARL-TR-1435; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A computational tool that models the terminal descent characteristics of a single or a cluster of parachutes is a technology that is needed by parachute designers and engineers. As part of a technology program annex (TPA), a joint effort between the U.S. Army Natick Research, Development, and Engineering Center (NRDEC) and the U.S. Army Research Laboratory (ARL) to develop this computational tool is now under way. As a first effort, attempts are being made to analyze both two-dimensional (2-D) and three-dimensional (3-D) flow fields around a parachute using a coupling procedure in which the fluid dynamics are coupled to 2-D and 3-D structural dynamic (SD) codes. This effort uses computational fluid dynamic (CFD) codes to calculate a pressure field, which is then used as an input load for the SD code. Specifically, this report presents the methods and results of the flow field plus the structural characteristics of a single axisymmetric parachute and a 3-D gore configuration for the terminal descent velocity. Computed results have been obtained using the payload weight and unstretched constructed geometry of the canopies as input. Significant progress has been made in determining the terminal descent flow field along with the terminal shape of the parachute. A discussion of the fluid and structural dynamics codes, coupling procedure, and the associated technical difficulties is presented. Examples of the codes' current capabilities are shown.

Author

*Computational Fluid Dynamics; Parachute Descent; Three Dimensional Flow; Structural Design; Dynamic Structural Analysis; Dynamic Response; Parachutes*


**19980025620**

**Tube and fine geometry alternatives for the design of absorption-heat-pump heat exchangers**

Garimella,, Srinivas, Western Michigan Univ., USA; Coleman, John W.; Wicht, Andreas; Journal of Enhanced Heat Transfer; 1997; ISSN 1065-5131; Volume 4, no. 3, pp. 217-235; In English; Copyright; Avail: Issuing Activity

The present study investigates the possibility of using highly compact, flat-tube/multilouver fin heat exchangers as replacements for conventional round-tube hydronic fluid-to-air heat exchangers used in space-conditioning applications. The advantages of these novel heat exchangers such as smaller frontal obstruction to air flow compared to round tubes (drag and fan power reduction), larger heat transfer coefficients due to the interrupted multilouver fins, and larger surface areas per unit volume can benefit absorption space-conditioning systems. A comparison of the performance of this new geometry versus conventional round-tube heat exchangers was performed through the quantification of the decrease in heat exchanger mass for equivalent heat duties. Within the limitations of the available heat transfer and friction factor correlations, round-tube heat exchangers with flat, wavy, louvered and annular fins, and flat-tube heat exchangers with multilouver fins were designed to meet typical absorption cycle design conditions. The effect of design variables such as parallel/serpentine flow arrangements of tubes, fin densities, core depth, and other parameters on heat transfer performance and tube- and air-side pressure drops was investigated. It was shown that flat-tube heat exchangers can transfer equivalent heat duties while meeting pressure drop constraints with a significant reduction in the overall mass and size.

Author (EI)

*Heat Exchangers; Heat Pumps; Tube Heat Exchangers; Fins; Heat Transfer; Heat Transfer Coefficients; Friction; Correlation*


**19980025635**

**Nonlinear dynamics of a rigid unbalanced rotor in journal bearings. Part II: Experimental analysis**

Adiletta, G., Universita degli Studi 'Federico II', Italy; Guido, A. R.; Rossi, C.; Nonlinear Dynamics; October, 1997; ISSN 0924-090X; Volume 14, no. 2, pp. 157-189; In English; Copyright; Avail: Issuing Activity

In the first part of the present investigation, the dynamic behavior of a rigid rotor supported on plain journal bearings was studied, focusing particular attention on its nonlinear aspects. In the present paper an experimental confirmation of the theoretical results is sought. The steel rotor of the experimental rig was given a constant circular cross section in order to fix in an easy way the two distances between supports corresponding, respectively, to the values of the lambda parameter assigned in [9]. Two steel

rings, each one with a series of holes and a clamping screw, were mounted onto the rotor with a small clearance. This arrangement made it possible to fix the positions of the rings and their holes respect to the rotor, so as to realize a pre-established unbalance. The two bronze journal bearings were characterized by a relatively low length/diameter ratio, and a relatively high value of the radial clearance and were lubricated with oil delivered from a thermostatic tank. In this way, despite the relative lightness of the rotor, the dimensionless static eccentricity epsilon(sub s) was given the high values that were apt to realize the operating conditions assumed in the theoretical analysis. The rotor was driven by means of a d.c. motor connected to a toothed belt-drive. Varying the rotor speed in the range 1000 divided by 10000 r.p.m., made it possible to assign the values of the modified Sommerfeld number assumed in the theoretical analysis. Three pairs of eddy-current probes were mounted in order to detect the trajectories of three points (C(sub 1), C and C(sub 2)) suitably fixed along the rotor axis. These orbits were finally put in comparison with the corresponding ones previously obtained through numerical analysis. The comparison pointed out that the experimental data were in good agreement with the theoretical predictions, despite the approximations that characterize the theoretical model and the unavoidable errors affecting measures in the course of the experimental test.

Author (EI)

*Journal Bearings; Rigid Rotors; Rotors; Rotation; Chaos*


**19980025704**

**Dynamics of gas-fluid nozzles** *Dinamika gazozhidkostnykh forsunok*

Andreev, Anatolij V., Russia; Bazarov, Vladimir G.; Grigor'ev, Stanislav S.; Dushkin, Andrej L.; Lyul'ka, Larisa A.; 1991; In Russian; ISBN 5-217-01341-9; Copyright; Avail: Aeroplus Dispatch

Results of a study of the nonstationary processes occurring in gas-fluid nozzles, that are commonly used in aircraft engines, are reported. In particular, attention is given to the linear dynamics of the gas and liquid stages of the nozzle, conditions leading to instability, generation of self-oscillations, and dynamic processes of interaction between the gas and fluid flows within the nozzle. Methods for the experimental study of the dynamic parameters of gas-fluid nozzles are analyzed. Attention is also given to the effect of nonstationary processes in nozzles on the liquid fuel spraying parameters and fuel mixing, methods of spray enhancement, and effect of nozzle dynamics on the completeness and stability of combustion and on the content of toxic substances in the combustion products.

AIAA

*Engine Inlets; Inlet Flow; Unsteady Flow; Two Phase Flow; Vaporizing*


**19980026432**

**Development and optimization of screw machines with a simulation model - Part 1: profile generation**

Stosic, N., City Univ., UK; Hanjalic, K.; Journal of Fluids Engineering, Transactions of the ASME; September, 1997; ISSN 0098-2202; Volume 119, no. 3, pp. 659-663; In English; Copyright; Avail: Issuing Activity

This paper presents a method for the design of twin screw compressors and expanders. which is based on a differential algorithm for defining the rotor profiles and an analytical model of the fluid flow and thermodynamic processes within the machine. Part I of the paper describes the algorithm for screw rotor profile generation. It demonstrates the conjugacy condition which, when solved explicitly, enables a variety of primary arcs to be defined either analytically or by discrete point curves. Its use greatly simplifies the design since only primary arcs need to be specified and these can be located on either the main or gate rotor or even on any other rotor including a rack, which is a rotor of infinite radius. Secondary arcs are then generated automatically from this. By such means any profile combination may be considered. The most efficient were obtained from a combined rotor-rack generation procedure. An example of this combination is given which produces a rotor profile with stiff lobes and a higher throughput than any other known type. Part II describes a mathematical model of the compression and expansion processes within positive displacement machines which has been well proven in its use for the design of reciprocating and screw compressors and screw expanders.

Author (EI)

*Algorithms; Rotors; Fluid Flow; Thermodynamics; Computerized Simulation*


**19980026433**

**Development and optimization of screw machines with a simulation model - Part II: thermodynamic performance simulation and design optimization**

Hanjalic, K., Delft Univ. of Technology, Netherlands; Stosic, N.; Journal of Fluids Engineering, Transactions of the ASME; September, 1997; ISSN 0098-2202; Volume 119, no. 3, pp. 664-670; In English; Copyright; Avail: Issuing Activity

This paper presents a method for the design of twin screw compressors and expanders which is based on a differential algorithm for defining the rotor profile and an analytical model of the fluid flow and thermodynamic processes within the machine.

Part I of the paper presents a method for screw rotor profile generation which simplifies and improves design procedures. An example is given of its use in the development of a new 'N' rotor profile, which is shown to be superior to other well-known types. Part II describes a numerical model of the thermodynamic and fluid flow processes within screw machines, which is valid for both the compressor and expander modes of operation. It includes the use of the equations of conservation of mass and energy applied to an instantaneous control volume of trapped fluid within the machine with allowance for fluid leakage, oil or other fluid injection, heat transfer, and the assumption of real fluid properties. by simultaneous solution of these equations, pressure-volume diagrams may be derived of the entire compression or expansion process within the machine. The procedure has been developed over a period of fifteen years and validated with experimental results obtained from both reciprocating and screw compressors and screw expanders, some of which are included. The rotor profile generation processor, thermofluid solver and optimizer, together with preprocessing facilities for the input data and graphical post-processing and CAD interface, have been incorporated into a design package which provided a suitable tool for analysis and optimization of twin screw machine design. An example of its use is given in the optimization of the gate tip radius of a selected compressor design.
Author (EI)
*Design Analysis; Fluid Injection; Performance Prediction; Computerized Simulation; Mathematical Models; Compressors; Fluid Flow; Thermodynamics*


### 19980026482

### Cellular approach meets machining challenge

Destefani, James D.; Manufacturing Engineering; September, 1997; ISSN 0361-0853; Volume 119, no. 3, pp. 56-61; In English; Copyright; Avail: Issuing Activity

To meet increased demand for the new general aviation and jet aircraft, Cesna Aircraft Co. purchased new production hardware which included horizontal machining centers (HMCs) equipped with pallet changers, CNC lathes, CNC vertical mills, and a mill/turn machine. The systems include Ultra 500 and FH-480 cells. In the latter, three FH-480 Palletech HMCs machine parts ranging from wing fittings to gear-support pieces in lot sizes from one to several hundred. The FH-480 machines' high speed/feed capabilities which have been important in producing a number of parts to net shape from solid blocks of aluminum have been a key to increased production. Other benefits include lower assembly labor costs plus elimination of fasteners and assembly tooling. EI
*Aircraft Industry; Manufacturing; Machining; Milling (Machining); Aircraft Equipment; Aircraft Parts; Aluminum*


### 19980026552

### Sensorless position detection for vector-controlled induction motor drives using an asymmetric outer-section cage

Cilia, Joseph, Univ. of Nottingham, UK; Asher, Greg M.; Bradley, Keith J.; Sumner, Mark; IEEE Transactions on Industry Applications; September-October, 1997; ISSN 0093-9994; Volume 33, no. 5, pp. 1162-1169; In English; Copyright; Avail: Issuing Activity

This paper describes a new method of obtaining a rotor position signal from a cage induction machine operating without a mechanical sensor. The method is based on introducing a circumferential variation in the resistance of a high-resistance outer-section cage of an induction-machine rotor. Simulation results using a linear 'double-cage' machine equivalent show that the method is feasible and provides incremental rotor position tracking with good dynamics. The paper describes an implementation of the method for a 30-kW double-cage machine having variable-gauge copper wire in the outer slots. It is shown that, while the rotor position-dependent signals are robust to changes in load, interference harmonics arising from slot saturation and rotor slot harmonics cause problems for rotor position tracking. These problems are discussed in relation to the present method and that of designed asymmetries in general.
Author (EI)
*Induction Motors; Mechanical Drives; Rotors; Positioning*


### 19980027181

### Theoretical study of pressure fluctuations downstream of a diffuser pump impeller - Part 2: effects of volute, flow rate and radial gap

Qin, W., Awamura Manufacturing Co., Ltd., Japan; Tsukamoto, H.; Journal of Fluids Engineering, Transactions of the ASME; September, 1997; ISSN 0098-2202; Volume 119, no. 3, pp. 653-658; In English; Copyright; Avail: Issuing Activity

The fundamental analysis in the first report was extended to calculate the unsteady flow induced by the interaction between impeller blades and diffuser vanes/volute casing in a diffuser pump. The unsteady flow in the diffuser vane passage, as well as the volute casing, is assumed to be induced by the five kinds of singularities - the bound vortices distributed on the impeller blades, diffuser vanes and volute casing wall, the sources at volute outlet, and the free vortices shed from the trailing edge of diffuser vanes.

Calculated unsteady pressures agree with the corresponding experimental data. and the calculated results showed the effects of the flow rate, volute casing and the radial gaps between impeller blade trailing edge and diffuser vane leading edge on the magnitude of unsteady pressure downstream of impeller.

Author (EI)

*Flow Velocity; Pressure Oscillations; Pump Impellers; Unsteady Flow; Rotors; Turbomachine Blades; Pumps; Vanes; Vortices*

## 19980027982

**Nonstationary waves in continuous media with a system of reflecting surfaces** *Nestatsionarnye volny v sploshnykh sredakh s sistemoj otrazhayushchikh poverkhnostej*

Babaev, Artashes Eh., Ukraine; 1991; In Russian; ISBN 5-12-001267-5; Copyright; Avail: Aeroplus Dispatch

An analytical method for solving nonstationary problems in aerohydroelasticity and hydroelectroelasticity is presented which makes it possible to reduce these problems to integral Volterra equations with retarded arguments. The method is used to investigate transient processes associated with the interaction of pressure waves, excited by internal wave sources of finite dimensions (with fixed and movable boundaries), with shells and systems of nested shells in the case where nonstationary loads are applied to multilayer bodies. Attention is also given to transient processes associated with the diffraction of acoustic shock waves by rigid bodies and elastic shells located near a plane boundary and also with the excitation, by nonstationary electric signals, of thick-walled and thin-walled shells and systems of nested shells in a liquid.

AIAA

*Aeroelasticity; Hydroelasticity; Wave Interaction; Volterra Equations; Solid Surfaces*

## 19980028064

**Optimum dimensions of plate fins for fin-tube heat exchangers**

Kundu, B., Indian Inst. of Technology, India; Das, P. K.; International Journal of Heat and Fluid Flow; October, 1997; ISSN 0142-727X; Volume 18, no. 5, pp. 530-537; In English; Copyright; Avail: Issuing Activity

Optimum dimensions of the fin for the fin-tube heat exchangers are determined in this study for both rectangular and equilateral triangular arrays of tubes. Maximum heat dissipation is obtained for a particular value of pitch length or fin thickness for a fixed fin volume. The optimization is done by the classical derivative method. Based on the mathematical analysis, design curves have been constructed for the design of optimum fins. Finally, it is verified that the concept of equivalent annular fin can be extended to calculate the optimum fin dimensions.

Author (EI)

*Tube Heat Exchangers; Fins; Heat Transfer; Heat Exchangers; Pipes (Tubes); Optimization*

## 19980028238

**Primer on air compressors**

Schneider, R. T.; Hydraulics & Pneumatics; January, 1997; ISSN 0018-814X; Volume 50, no. 1, pp. 159-162, 164; In English; Copyright; Avail: Issuing Activity

Compressed air is one of the most important power media used in industries. There are two basic types of compressor for industrial use, the positive and dynamic air compressors. In positive-displacement compressors, ambient air is isolated in a volume that is mechanically reduced to increase air pressure. The mechanical action may use a crankshaft, reciprocating pistons or rotary elements. In dynamic compressors, on the other hand, the mechanical action of rotating impellers accelerates ambient air as it passes through the machine. Dynamic compressors are identified as centrifugal or axial depending on the manner in which air flows through them.

EI

*Centrifugal Compressors; Compressors; Electric Motors; Mechanical Drives; Starters; Cost Effectiveness*

## 19980028239

**Air-line drains - automatic and reliable**

Schneider, R. T.; Hydraulics & Pneumatics; March, 1997; ISSN 0018-814X; Volume 50, no. 3, pp. 39; In English; Copyright; Avail: Issuing Activity

Air-line drains are some arrangement, device, or combination of devices that protect downstream components from liquid water that condenses in the air stream. A common characteristic of these arrangements is that they remove condensate from the

main air lines and deliver it to an area where it poses no threat. A second characteristic is that they remove accumulated condensate before it reaches a volume that will interfere with the system's performance.

EI

*Civil Aviation; Commercial Aircraft; Compressors; Separators; Receivers; Fluid Filters; Drying Apparatus*


### 19980028561

### High output power characteristics of revolving-armature type commutatorless motor

Kitamura, Hiroyuki, Toshiba Corp., Japan; Tamura, Yoshiaki; Electrical Engineering in Japan (English translation of Denki Gakkai Ronbunshi); July 30, 1997; ISSN 0424-7760; Volume 120, no. 2, pp. 82-94; In English; Copyright; Avail: Issuing Activity

The authors and others developed a 15 kW revolving-armature type commutatorless motor deriving high magnetic loading. The commutatorless motor was first manufactured with interpole and compensating windings having a construction allowing easy installation and removal of interpoles. It was found from this experiment that this motor was improved in overload torque and the effect of interpoles did not affect compensating windings of the spare angle improvement. Therefore, the compound commutatorless motor (with compensating windings) was manufactured as an experiment. A high output of 190% power was derived by this motor and compensating windings were not needed. By characteristics analysis and simulation, the main factor by which this high output was obtained was that the leakage reactance X of this motor was half that of old commutatorless motors. This paper reports this effect, including the experimental data.

Author (EI)

*Synchronous Motors; Rotors; Winding; Speed Control; Numerical Analysis; Vectors (Mathematics)*


### 19980028601

### Computation of unsteady flow through steam turbine blade rows at partial admission

He, L., Univ. of Durham, UK; Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy; 1997; ISSN 0957-6509; Volume 211, no. 3, pp. 197-205; In English; Copyright; Avail: Issuing Activity

The effects of unsteady flow on the aerodynamic performance of steam turbine blade row at partial admission are investigated. It is shown that cyclic pumping and sucking phenomenon occurs in the rotor blade row of the first stage, resulting in large unsteady loading and marked mixing loss. For a single stage at a given admission rate, a blocking arrangement with two flow segments is shown to be much more detrimental than one arc of admission, because of the extra mixing loss. The results for a two-stage case, however, suggest that the decaying rate of circumferential non-uniformities could be far more importance for performance. Thus, an enhanced mixing loss in the first stage might be beneficial to the overall efficiency of a multistage turbine.

EI

*Computational Fluid Dynamics; Steam Turbines; Turbine Blades; Unsteady Flow; Turbomachine Blades; Aerodynamics*


### 19980028630

### Vibration of a multi-crack rotor

Tsai, T. C., Natl. Central Univ., Taiwan, Province of China; Wang, Y. Z.; International Journal of Mechanical Sciences; September, 1997; ISSN 0020-7403; Volume 39, no. 9, pp. 1037-1053; In English; Copyright; Avail: Issuing Activity

In this paper a mode of free vibrational analysis of multi-cracked rotor is presented. The cracks are assumed to be in the first mode of fracture, i.e. the opening mode. Based on the Timoshenko beam theory, the frequency equation can be constructed by assembling the transfer matrix of each segment of the multi-step and multi-cracked rotor, and then solve the frequencies as well as the corresponding mode shapes of the cracked rotor. The effects of both relative distances along axis and/or orientations of cracks are considered in free vibration analysis. An algorithm and numerical examples are included.

Author (EI)

*Free Vibration; Matrices (Mathematics); Rotors; Vibration; Cracks; Fracture Mechanics; Matrix Theory*


### 19980029968

### Passivity-based method for induction motor control

Gokdere, Levent U., Univ. of South Carolina, USA; Simaan, Marwan A.; IEEE Transactions on Industrial Electronics; October, 1997; ISSN 0278-0046; Volume 44, no. 5, pp. 688-695; In English; Copyright; Avail: Issuing Activity

The control of an induction motor is a difficult problem, since the dynamics of the induction motor are nonlinear, the rotor electrical state variables (i.e., rotor fluxes or currents) are usually unavailable for measurement, and the motor parameters can vary significantly from their nominal values. The main purpose of this paper is to develop a control algorithm that forces the induction motor to track time-varying speed, position, and flux trajectories without knowledge of the rotor electrical state variables. To achieve this, a passivity-based method is developed. The key point with this method is the identification of terms, known as work-

less forces, which appear in the dynamic equations of the induction motor but do not have any effect on the energy balance equation of the induction motor. These terms do not influence the stability properties of the induction motor and, hence, there is no need to cancel them with feedback control. This leads to a simpler control structure and enhances the robustness of the control system. Experimental results show that the passivity-based method provides close tracking of time-varying speed, position, and flux trajectories without knowledge of the rotor electrical state variables.

Author (EI)

*Induction Motors; Control Equipment; Nonlinear Systems; Rotors; Winding; Parameter Identification; Algorithms*

### 19980030065

### Flow around the sections of rotor blading of a turbine stage with relatively long blades at off-design conditions

Stastny, M., SKODA Turbines, Czech Republic; Safarik, P.; Horejsi, I.; Matas, R.; Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy; 1997; ISSN 0957-6509; Volume 211, no. 3, pp. 207-213; In English; Copyright; Avail: Issuing Activity

The paper deals with the results of aerodynamic research of flow through blade cascades at off-design conditions. Variations of inlet velocity vectors during the operation of the stage at off-design flow conditions are calculated and compared with experimental results. The detailed measurements provide data on aerodynamic parameters, kinetic energy losses and flow structure. Leading edge flow separation occurs mainly at off-design incidences and is proved to be the reason for the considerable kinetic energy loss increase. The occurrence of unsteady aerodynamic phenomena and forces at off-design performance of blade cascades is shown. The transonic flow structure is studied in detail and experimental data analysis and results of numerical calculations are presented.

Author (EI)

*Energy Dissipation; Kinetic Energy; Turbomachine Blades; Transonic Flow; Rotors; Turbines; Aerodynamics*

### 19980030068

### Modelling of spanwise mixing in compressor through-flow computations

Dunham, J., Propulsion Technology Dep., UK; Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy; 1997; ISSN 0957-6509; Volume 211, no. 3, pp. 243-250; In English; Copyright; Avail: Issuing Activity

Although three-dimensional Navier-Stokes computations are coming into use more and more, streamline curvature through-flow computations are still needed, especially for multistage compressors, and where codes which run in minutes rather than hours are preferred. These methods have been made more realistic by taking account of end-wall effects and spanwise mixing by four aerodynamic mechanisms: turbulent diffusion, turbulent convection by secondary flow, spanwise migration of aerofoil boundary layer fluid and spanwise convection of fluid in blade wakes. This paper describes the models adopted in the DRA streamline curvature method for axial compressor design and analysis. Previous papers are summarized briefly before describing the new part of the model - that accounting for aerofoil boundary layers and wakes. Other changes to the previously published annulus wall boundary layer model have been made to enable it to cater for separations and end bends. The resulting code is evaluated against a range of experimental and computational results.

Author (EI)

*Computational Fluid Dynamics; Secondary Flow; Compressors; Fluid Flow; Mixing; Mathematical Models*

### 19980030072

### Analysis on transient thermal stresses in an annular fin

Wu, Shang-sheng, Chinese Military Acad., Taiwan, Province of China; Journal of Thermal Stresses; September, 1997; ISSN 0149-5739; Volume 20, no. 6, pp. 591-615; In English; Copyright; Avail: Issuing Activity

Transient thermal stresses are an important consideration in production processes involving large temperature changes. Recently, thermal stresses have also become significant in design problems related to microelectronic devices through their effects on material properties and system parameters. to calculate the thermal stresses, three kinds of methods are available. The first is the analytical method, in which the elastic theory is used to find the exact solution. The second approach consists of some kind of approximate technique, such as a perturbation procedure. The third method is the use of a numerical process, such as a finite-difference or a finite-element method. This article investigates the transient thermal stresses in an annular fin with its base subjected to a heat flux of a decayed exponential function of time. In order to obtain the solution of the governing equation, which is a partial differential equation, the following procedures of analysis are used. 1. Normalize the governing partial differential equation subject to appropriate initial and boundary conditions. 2. Take the Laplace transform of the resulting equation with respect to time. 3. Utilize the exponential-like solutions introduced by Keller and Keller to solve the transformed system. 4. Achieve the inverse Laplace transform by means of complex contour integration and the residue theorem. 5. Substitute the temperature distribution

function into the governing equation of thermal stresses. Then use Simpson's rule to obtain the thermal stress distribution as a function of time and position of the fin.
Author (EI)

*Thermal Stresses; Fins; Heat Transfer; Stress Analysis; Temperature Effects; Heat Flux*

**19980032237**
**Determination of the asynchronous load on a rotor from the measured internal forces**
Phan, A. -V., Inst. Natl. Polytechnique de Grenoble, France; Reynaud, G.; Journal of Sound and Vibration; September 11, 1997; ISSN 0022-460X; Volume 206, no. 1, pp. 15-22; In English; Copyright; Avail: Issuing Activity

Experimental contributions currently play an important role in determining hydraulic forces due to cavitation. Up to the present date, there is no computational analysis which has proven to be successful in this domain. Experiments are usually carried out to measure the resulting internal forces in a model because these forces are crucial for designing elements under cavitational flows. This paper presents a numerical approach using the theory of rotordynamics coupled with the finite element method (FEM) to determine the hydraulic load on a rotor from the internal forces measured in a cross-section of the rotor. Once the load is found, a program developed can be used to compute the internal forces in any cross-section of interest and to evaluate dynamic effects on the rotor. Two illustrative examples are presented to show the validity of this approach.
Author (EI)

*Loads (Forces); Rotor Dynamics; Cavitation Flow; Rotors; Mathematical Models; Finite Element Method; Computer Programs*

**19980034570**
**Computational study of contoured plug-nozzle jet noise**
Das, I. S., Pennsylvania State Univ., USA; Khavaran, A.; Krejsa, E. A.; Journal of Sound and Vibration; September 18, 1997; ISSN 0022-460X; Volume 206, no. 2, pp. 169-194; In English; Copyright; Avail: Issuing Activity

A computational noise study of a scale model of an axisymmetric ideally contoured plug-nozzle (CPN) is presented. The CPN has an exit diameter of 45 mm and the geometrical configuration is such that the jet flow is shockless at the design pressure ratio, $xi(sub d) = 3.62$. The gas dynamics of the jet flows has been predicted using the NPARC Computational Fluid Dynamics code with the k-epsilon turbulence model. The gas dynamics data are then used to perform the noise computations based on the modified General Electric MGB code. The study covers a range of pressure ratios, 2.0 less than or = xi less than or = 5.0. The agreement of the computational aeroacoustic results with the reported experimental data is favorable. At design pressure ratio (shockless flow), the predicted noise levels are with 3 dB. At the off-design pressure ratios (flows with shocks), the theory predicts the noise levels within 5 dB, except at very high frequencies for pressure ratios farthest from the design pressure ratio when deviations up to 8 dB are noted. The computed directivity patterns do not represent the reported experimental trends well. The mechanism of shock formation in the CPN jet flows is noted to be basically different from those in the convergent nozzle and convergent-divergent nozzle jet flows. The computational results indicate consistent noise reduction effectiveness of the CPN relative to the equivalent convergent and convergent-divergent nozzles for all operating pressure ratios.
Author (EI)

*Jet Aircraft Noise; Plug Nozzles; Turbulence Models; Noise (Sound); Computational Fluid Dynamics; Mathematical Models*

**19980034829**  Moscow State Univ., Russia
**Experimental Investigation of a Possibility of Application of a Microwave Streamer Gas Discharge for Ignition of Fuel in a Jet Engine**  *Final Report*
Ershov, Elksei, Moscow State Univ., Russia; Jan. 1997; 78p; In English
Contract(s)/Grant(s): F61708-97-W-0009
Report No.(s): AD-A333334; EOARD-SPC-97-4003; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report contains results from a contract tasking Moscow State University as follows: The contractor will investigate possible application of a microwave streamer gas discharge for ignition of fuel in a jet engine.
DTIC

*Ignition; Jet Engines; Microwaves; Plasma Generators*

**19980036143**
**Wind tunnel and numerical experiments exploring the interactions between an ejecta curtain and an atmosphere**
Barnouin-Jha, O. S., Brown Univ., USA; Schulz, P. H., Brown Univ., USA; Lever, J., U.S. Army, Cold Regions Research and Engineering Lab., USA; 1997, pp. 67, 68; In English; Copyright; Avail: AIAA Dispatch

Analyzing the flow past small porous plates provides the groundwork for understanding the interactions between an atmosphere and an ejecta curtain at planetary scales. The present study develops criteria for flow traversing a porous structure, determining wind speed losses when atmosphere flows through the upper semipermeable portions of an ejecta curtain, and assesses wind speed losses due to atmospheric compressibility. These results permit establishing the amount of ejecta entrainment at broad scales, and the effect of this entrainment on ejecta transport and deposition. Eventually, observed ejecta morphologies of planetary craters formed in an atmosphere will provide information on impact conditions such as target properties (including volatile content) and atmospheric density.

Author (AIAA)

*Ejecta; Wind Tunnels; Porous Plates; Planetary Atmospheres; Planetary Craters*


**19980036338**  Prairie View Agricultural and Mechanical Coll., Dept. of Electrical Engineering, TX USA

**Study of Radiation Effects Electronics at Atmospheric Altitudes**  *Final Report*

Wilkins, Richard, Prairie View Agricultural and Mechanical Coll., USA; Mar. 30, 1998; 7p; In English

Contract(s)/Grant(s): NAG4-129

Report No.(s): NASA/CR-1998-207660; NAS 1.26:207660; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A test bed for the in situ evaluation of electronic devices for high altitude aircraft was developed. A prototype of the test bed, suitable for operation on a research aircraft, was built and readied for ground tests. The principle investigator established a working relationship with the Project APEX team at Dryden with the intent of flying the test bed "piggyback" on an Project APEX balloon in 1998. Contact was also established with NASA contractors charged with operating the ER-2 aircraft now at Dryden.

Author

*Experimentation; Evaluation; Electronic Equipment; Research Aircraft; Radiation Effects; Ground Tests*


**19980036463**

**High efficiency binary-duct self-suction mixer impeller (I)**

Li, Qien, South China Univ. of Technology, China; Huang, Qingmin; Lin, Qihao; Huaxue Gongcheng/Chemical Engineering; August 25, 1997; ISSN 1005-9954; Volume 25, no. 4, pp. 46-49; In Chinese; Copyright; Avail: Issuing Activity

Based upon the fluiddynamical considerations, the author designed an enhanced selfsuction mixer impeller which has an air suction rate 3.33 approx. 5 times and a specific mass transfer coefficient 1.32 approx. 1.95 times that of the 12 blades rushton turbine. Comparing with the current high efficiency self-suction impellers, the enhanced impeller has an air suction rate 50% approx. 75% more and a specific mass transfer coefficient 6% approx. 81% more still.

Author (EI)

*Mass Transfer; Rotors; Fluid Dynamics*


**19980036978**  NASA Langley Research Center, Hampton, VA USA

**Computational Aeroheating Predictions for X-34**

Kleb,William H., NASA Langley Research Center, USA; Wood, William A., NASA Langley Research Center, USA; Gnoffo, Peter A., NASA Langley Research Center, USA; Jan. 1998; 46p; In English; Original contains color illustrations

Contract(s)/Grant(s): RTOP 242-80-01-01

Report No.(s): NASA/TM-1998-206289; NAS 1.15:206289; L-17687; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Radiative equilibrium surface temperatures, heating rates, streamlines, surface pressures, and flow-field features as predicted by the Langley Aerothermodynamic Upwind Relaxation Algorithm (LAURA) are presented for the X-34 Technology Demonstrator. Results for two trajectory points corresponding to entry peak heating and two control surface deflections are discussed. This data is also discussed in the context of Thermal Protection System (TPS) design issues. The work presented in this report is part of a larger effort to define the X-34 aerothermal environment, including the application of engineering codes and wind-tunnel studies.

Author

*Aerothermodynamics; Aerodynamic Heating; Surface Temperature; Heat Transfer; Flow Distribution; Computational Fluid Dynamics; Reynolds Averaging; Hypersonic Flow; Navier-Stokes Equation*

# 13
# GEOSCIENCES

*Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.*

**19980030364**

**Implications of NO(sub y) emissions from subsonic aircraft at cruise altitude**

Lee, S. H., Cranfield Univ., UK; Le Dilosquer, M.; Singh, R.; Hobbs, S. E.; Giannakopoulos, C.; Plantevin, P. H.; Law, K. S.; Pyle, J. A.; Rycroft, M. J.; Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering; 1997; ISSN 0954-4100; Volume 211, no. 3, pp. 157-168; In English; Copyright; Avail: Issuing Activity

The exhaust emissions from civil subsonic aircraft at cruise altitude are important man-made sources that pollute the upper troposphere and the lower stratosphere (8-12 km). The formation of NO(sub y) species from NO(sub x), both before and after the exit nozzle, have created increasing environmental concerns. Flight histories of Boeing 747-400 aircraft during the cruise stage between selected city pairs have been simulated using a computer program developed at Cranfield University. The passive distribution of NO(sub x) and HNO(sub 3) is calculated using the UGAMP three-dimensional chemical transport model. The sink of NO(sub x), which is HNO(sub 3), is parameterized using an exponential decay process with an altitude-dependent lifetime. The model also includes transport by advection, vertical diffusion and convection. These simulations for January and July are analyzed in terms of the resulting mean volume mixing ratios for both NO(sub x) and HNO(sub 3).
Author (EI)

*Applications Programs (Computers); Atmospheric Models; Aerosols; Air Pollution; Nitrogen Oxides; Troposphere; Transport Aircraft*

**19980036534**

**Vector-controlled doubly-fed induction generator for a variable-speed wind turbine application**

Atkinson, D. J.; Lakin, R. A.; Jones, R.; Transactions of the Institute of Measurement and Control; 1997; ISSN 0142-3312; Volume 19, no. 1, pp. 2-12; In English; Copyright; Avail: Issuing Activity

This paper examines the performance of a vector-controlled doubly-fed induction generator for wind turbine use. The scheme is considered for variable-speed-range applications to produce a greater wind energy capture from varying wind velocity. A major advantage of the doubly-fed scheme over the squirrel-cage generator is the reduced volt-ampere rating of the power converter used to control the rotor current. The singly-fed scheme requires that the power converter is able to carry the full generator output. In order to produce decoupled regulation of active and reactive output power, the rotor current is controlled using field orientation principles. The measurement of rotor position and the grid voltage vector position allows the rotor current to be controlled in a reference frame closely associated with the stator magnetizing current. The stator active and reactive power are also measured and fed back into outer P(sub s) and Q(sub s) control loops. The P(sub s) and Q(sub s) controllers produce d and q axis rotor current demands for the inner rotor current vector controller. By control of the reactive power loop the generator can be made to produce power at unity power factor. The vector control of rotor current is carried out using a commercial PWM inverter equipped with vector control hardware as standard. The inverter also produces a unity power factor sinusoidal current interface to the grid network. The performance of the scheme is examined using both simulation and experimental results. The decoupling control of active and reactive power is demonstrated and shows the ability to generate power at unity power factor.
Author (EI)

*Wind Turbines; Synchronism; Mechanical Drives; Power Converters; Rotors; Winding*

# 14
# LIFE SCIENCES

*Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.*

**19980033538**  British Aerospace Defence Ltd., Preston,  UK

**Cockpit Usability - A Design Checklist**

Turner, John, British Aerospace Defence Ltd., UK; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 8p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

'Usability' represents the degree of help or hindrance provided to the pilot or crew member as they attempt to complete the operational missions with which they may be tasked; it also acknowledges the financial/technological realities against which

designs are developed. The factors which impact cockpit and system usability, some of the steps necessary to achieve it, and suggested items for inclusion in a usability design checklist are discussed.
Derived from text
*Cockpits; Pilots; Crews; Constraints*


**19980036975** Georgia Inst. of Tech., School of Industrial and Systems Engineering, Atlanta, GA USA
**Pilot Non-Conformance to Alerting System Commands** *Final Report, 1 Jul. - 31 Dec. 1997*
Pritchett, Amy, Georgia Inst. of Tech., USA; 1997; 4p; In English
Contract(s)/Grant(s): NAG 2-1146
Report No.(s): NASA/CR-97-207659; NAS 1.26:207659; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
    This research project examined the effects of consonance between cockpit displays and alerting system as a technique to encourage pilots to conform to alerting system commands. An experiment used the task of collision avoidance during closely spaced parallel approaches as a case study, building upon previous experiments which identified instances of non-conformance and conflicts between the alerting criteria preferred by pilots, compared to that used by alerting systems. Using a workstation based, part-task simulator, each of 45 subjects completed 45 experiment runs. In each run, the subjects were told they were flying an approach. Their primary task was to keep their wings level despite turbulence through the use of a sidestick. The sidestick commands did not affect the path of the aircraft, however, so that consistent approach paths were be followed. Their secondary task was to indicate when an aircraft on a parallel approach is blundering towards them, as evidenced by the traffic display. Subjects were asked to press different buttons indicating whether they feel an avoidance maneuver is required by the traffic situation or not. At the completion of each run, subjects were asked to rate their confidence in their decision and, if appropriate, to rate the timeliness of automatic alerts when had been given. Three different automatic alert conditions were tested. The "No Automatic Alerts Given" condition is self-explanatory. In the "Automatic Alerts Based on NTZ Criteria" condition, an automatic alert was given when the NTZ criteria was triggered; this criteria is consistent with subject reactions in other studies, in which subjects were found to react, on average, when the other aircraft was 1350 min to the side of the own aircraft. In the "Automatic Alerts Based on MIT Criteria" condition, an automatic alert was given when the MIT criteria was triggered; this criteria was developed by Carpenter and Kuchar for parallel approaches to have better performance, at the cost of increased complexity and higher sensitivity to pilot non-conformance. Three displays were tested. The "Baseline Display" is based on a moving map display, with a top-down view, track-up orientation, iconic presentation of the other aircraft's positions and a text presentation of the other aircraft's altitude. The "NTZ Alert Criteria Shown" display added to the Baseline Display an explicit presentation on the display of the boundary delineating the NTZ criteria, allowing for quick comparison of the other aircraft's position relative to this alert criteria. Likewise, the "MIT Alert Criteria Shown" display added to the Baseline Display an explicit presentation on the display of the boundary delineating the MIT criteria, allowing for quick comparison of the other aircraft's position relative to this alert criteria The test matrix for this experiment was three dimensional, varying displays, alerts and traffic conflict scenarios.
Derived from text
*Research and Development; Collision Avoidance; Display Devices; Simulators; Cockpits*


# 15
# MATHEMATICAL AND COMPUTER SCIENCES

*Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.*


**19980024967**

**A new algorithm for high maneuvering targets tracking**
Quan, Taifan, Harbin Inst. of Technology, China; Mu, Dong, Harbin Inst. of Technology, China; Yaun, Yeshu, Harbin Inst. of Technology, China; Liu, Yongtan, Harbin Inst. of Technology, China; 1991, pp. 129-132; In English; Copyright; Avail: Aeroplus Dispatch
    A robust Kalman filter based on a multistructure model for non-Gaussian noise is proposed for the maneuvering target tracking problem. The satellite model for the target is changed by introducing extra state components when a maneuver is detected and the maneuver, modeled as an acceleration, is estimated recursively.
AIAA
*Aircraft Maneuvers; Kalman Filters; Aircraft Detection; Target Recognition*

**Analysis of vibration spectral maps through the Harmonics Evolution Diagram** *Analisis de mapas espectrales de vibracion mediante el diagrama de evolucion de armonicos*

Valverde, A., Univ. de Murcia, Spain; Gomez De Leon, F. C.; Informacion Tecnologica; 1997; ISSN 0716-8756; Volume 8, no. 4, pp. 349-354; In Spanish; Copyright; Avail: Issuing Activity

This paper shows a new methodology, so-called Harmonics Evolution Diagram, for the interpretation and computerized treatment of spectral information. The method is explained with detail and is applied to the vibration analysis of an electric motor coupled to an air compressor. As shown, the method allows to register qualitative aspects of the spectral map in a matrix structure, facilitating the detection of annomalies that otherwise could not be observed. The Harmonics Evolution Diagram represents a powerful tool for vibration analysis and for the detection of annomalous machine behavior.
EI
*Spectrum Analysis; Vibration Mode; Fast Fourier Transformations; Electric Motors; Compressors*

Odyssey Research Associates, Inc., Ithaca, NY USA
**Formal Specification of a Flight Guidance System** *Final Report*
Fung, Francis, Odyssey Research Associates, Inc., USA; Jamsek, Damir, Odyssey Research Associates, Inc., USA; Jan. 1998; 101p; In English
Contract(s)/Grant(s): NAS1-20335; RTOP 519-30-31-01
Report No.(s): NASA/CR-1998-206915; NAS 1.26:206915; TR-97-0042; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This document contains a formal specification for the mode logic of a Flight Guidance System (FGS) and a discussion of issues raised by writing the formal specification. A flight guidance system is an example of life-critical code; this project aims to demonstrate the effectiveness of formal methods in the requirements analysis and design of life-critical systems.
Derived from text
*Flight Control; Control Theory; Aircraft Control; Functional Design Specifications*

**Virtual environments and ergonomics: needs and opportunities**
Wilson, John R., Univ. of Nottingham, UK; Ergonomics; October, 1997; ISSN 0014-0139; Volume 40, no. 10, pp. 1057-1077; In English; Copyright; Avail: Issuing Activity

Although based on a still immature technology, virtual environments appear to have potential for applications in industry, commerce, medicine and education. The role of ergonomics will be in development of improved virtual environment interfaces and in enabling better utilization of the technology through specifying user needs and requirements and developing evaluation methodologies. by extension, ergonomists will also be involved in building virtual environments for use in areas of ergonomics activity such as workplace layout, interface design, procedures testing, education and training. This paper overviews virtual environment attributes and capabilities and proposes a framework for their specification, development and evaluation, before summarizing current ergonomics research issues. Current work on participant side effects is summarized. A strong case is made for the potential value of ergonomics for virtual environments and vice versa.
Author (EI)
*Display Devices; Flight Simulators; Human Factors Engineering; Motion Sickness; Signs and Symptoms; Virtual Reality; Human-Computer Interface; Technologies; Computerized Simulation*

Wright Lab., Wright-Patterson AFB, OH USA
**Trends in Future Combat Aircraft Development**
Davis, R. W., Wright Lab., USA; Selegan, D. R., Wright Lab., USA; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 16p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The USA Air Force is currently going through a planning process to structure itself for the 21st Century. There have been several studies on this subject such as "Joint Vision 2010" that discuss mission requirements and the Air Force Scientific Advisory Board's "New World Vistas" that discuss relevant technology issues for the future. Figure 1 shows the six core competencies that the Air Force will maintain into the 21st Century. These core competencies will focus the Air Force mission areas and shorten the lines of communication between the user and the acquisition/research community through a new concept for the Air Force called Battle Labs. Purpose of the Battle Labs is to provide for the rapid assessment of technology on operational requirements under realistic conditions. This paper provides an update to these initiatives and provides the reader with an overview of the current

Air Force Modernization Planning Process (AFMPP) and how it is effecting the Air Force Science and Technology Plans into the next millennium. This paper highlights several technology thrusts that will have an impact on air operations in the next Century. Derived from text

*Trends; Aircraft Design; Fighter Aircraft; Research and Development; Mission Planning*


**19980033519**  Daimler-Benz Aerospace A.G., Military Aircraft Div., Munich, Germany

**Future Combat Aircraft Development in Europe**

Bridel, G., Daimler-Benz Aerospace A.G., Germany; Ross, H. G., Daimler-Benz Aerospace A.G., Germany; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 12p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Within the last decade three new combat aircraft have been developed in parallel in Europe: The Eurofighter, the Rafale and the Gripen. This happened probably for the last time. New scenarios and missions, but in particular reduced defence budgets, the growing integration into a European Union and strong competition on the European and world market, in particular from the US and Russia, will eventually force (1) European nations to formulate common requirements; (2) the national Governments to coordinate their research and development efforts; (3) the airforces to coordinate their training, operation and maintenance activities; and (4) the national industries to form a common European military aircraft company, if a truly competitive military aircraft development and production capability in Europe is to be maintained.
Author

*Aircraft Design; Fighter Aircraft; Research and Development; JAS-39 Aircraft*


**19980033521**  National Defence Headquarters, Project Management Office, Armed Forces Utility Tactical Transport Helicopter, Ottawa, Ontario Canada

**Cost Benefits in the Acquisition of a Utility Tactical Transport Helicopter Fleet for the Canadian Forces**

Caux, L. A., National Defence Headquarters, Canada; Delaney, R. G., National Defence Headquarters, Canada; Future Aerospace Technology in the Service of the Alliance; Dec. 1997; Volume 1; 10p; In English; Also announced as 19980033517; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The requirement for a Utility Tactical Transport Helicopter (UTTH) fleet is derived from the roles of the Canadian Forces and the specific missions assigned to the Land and Air Forces. In general, UTTH resources can be called upon to conduct operations in any of the following general mission areas: (a) Operational and training support to the land forces and other CF organizations; (b) International peacekeeping operations; and (c) Operations in aid of the civil authority.
Derived from text

*Helicopters; Military Operations; Military Aircraft; Costs*


## 16
## PHYSICS

*Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.*


**19980025145**

**Aeroelastic structural acoustic coupling: implications on the control of turbulent boundary-layer noise transmission**

Clark, Robert L., Duke Univ., USA; Frampton, Kenneth D.; Journal of the Acoustical Society of America; September, 1997; ISSN 0001-4966; Volume 102, no. 3, pp. 1639-1647; In English; Copyright; Avail: Issuing Activity

The aeroelastic structural acoustic coupling of a panel subjected to turbulent boundary laser noise sources is modeled. The aim is to realize the fluid, structure, and acoustic modeling in typical state-variable form. Results emphasized the importance of including aeroelastic coupling in models used to predict performance of active structural acoustic control of aircraft panels. In both subsonic and supersonic flow conditions, the panel dynamics are significantly modified in the presence of external flow.
EI

*Acoustic Coupling; Boundary Layers; Mach Number; Turbulent Boundary Layer; Acoustic Propagation; Noise (Sound); Panels; Aircraft Equipment; Aircraft Parts*

**Noise control of two-wheeler scooter engine**

Tandon, N., Indian Inst. of Technology, India; Nakra, B. C.; Sarkar, B.; Adyanthaya, V.; Applied Acoustics; August, 1997; ISSN 0003-682X; Volume 51, no. 4, pp. 369-380; In English; Copyright; Avail: Issuing Activity

    High noise generated by the engine of a two-wheeler scooter has been analyzed. Sound intensity measurements were performed on the engine to identify the sources of high noise. Sound intensity maps and intensity spectra of the engine were obtained. The measurement results indicate that the high noise was mainly generated by the cylinder of the engine. Piston slap and resonance of cylinder head fins were identified as the causes of high noise. Substantial reduction in the engine noise was obtained when the piston-cylinder clearance was reduced and the natural frequencies of the cylinder head fins were changed.
Author (EI)
*Noise Reduction; Sound Intensity; Pistons; Fins; Heat Transfer*

NASA Langley Research Center, Hampton, VA USA

**Design and Use of Microphone Directional Arrays for Aeroacoustic Measurements**

Humphreys, William M., Jr., NASA Langley Research Center, USA; Brooks, Thomas F., NASA Langley Research Center, USA; Hunter, William W., Jr., NASA Langley Research Center, USA; Meadows, Kristine R., NASA Langley Research Center, USA; 1998; 26p; In English; Aerospace Sciences Meeting and Exhibit, 12-15 Jan. 1998, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA/TM-1998-207321; NAS 1.15:207321; AIAA Paper 98-0471; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

    An overview of the development of two microphone directional arrays for aeroacoustic testing is presented. These arrays were specifically developed to measure airframe noise in the NASA Langley Quiet Flow Facility. A large aperture directional array using 35 flush-mounted microphones was constructed to obtain high resolution noise localization maps around airframe models. This array possesses a maximum diagonal aperture size of 34 inches. A unique logarithmic spiral layout design was chosen for the targeted frequency range of 2-30 kHz. Complementing the large array is a small aperture directional array, constructed to obtain spectra and directivity information from regions on the model. This array, possessing 33 microphones with a maximum diagonal aperture size of 7.76 inches, is easily moved about the model in elevation and azimuth. Custom microphone shading algorithms have been developed to provide a frequency- and position-invariant sensing area from 10-40 kHz with an overall targeted frequency range for the array of 5-60 kHz. Both arrays are employed in acoustic measurements of a 6 percent of full scale airframe model consisting of a main element NACA 632-215 wing section with a 30 percent chord half-span flap. Representative data obtained from these measurements is presented, along with details of the array calibration and data post-processing procedures.
Author
*Aeroacoustics; Microphones; Aerodynamic Noise; Noise Measurement*

# 17
# SOCIAL SCIENCES

*Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.*

**Current trends in air transport with specific reference to the legal field** *Tendencias contemporaneas del transporte aereo con especial referencia al campo juridico*

Donato, Marina, Comision Latinoamericana de Aviacion Civil, Uruguay; CIDA; 1991; ISSN 0797-0072; Volume 15, no. E16, pp. 11-26; In Spanish; Copyright; Avail: Aeroplus Dispatch

    An evaluation is made of trends in the worldwide absorption, in both national and international operations, of the terminology and conceptual framework of U.S. airline deregulation. These practices encompass passenger capacity predetermination, the hierarchical administration of operating rights, and bilateral tariff agreements. Attention is given to the emergence of transnational consortiums, such as the United/USAIR 'Apollo Covia' Eastern/Continental 'System One', and All-Nippon Airways/Japan Airlines/Quantas 'Fantasia'. The effects of these trends on Latin American airline operations are noted.
AIAA
*Air Traffic; Transport Aircraft; Air Law; Civil Aviation*

**Legal framework for air freight according to the Warsaw Convention - Rights of the addressee** *Regimen juridico de la carga aerea de acuerdo con el Convenio de Varsovia - Derecho del destinatario*

An overview is presented of the apportionment of rights between senders and addressees in air mail and other air freight. Attention is given to the stipulations of the Warsaw Convention.
AIAA

*Air Cargo; Law (Jurisprudence); Air Law*

# Subject Term Index

## A

ACCIDENT PREVENTION, 9
ACOUSTIC COUPLING, 47
ACOUSTIC EMISSION, 23
ACOUSTIC PROPAGATION, 47
ACTIVE CONTROL, 7, 29
ACTUATORS, 19
ADHESIVE BONDING, 16, 31, 35
AEROACOUSTICS, 48
AERODYNAMIC CHARACTER-
    ISTICS, 21, 30, 33, 34
AERODYNAMIC COEFFICIENTS, 5
AERODYNAMIC HEATING, 43
AERODYNAMIC LOADS, 4
AERODYNAMIC NOISE, 48
AERODYNAMIC STABILITY, 1, 15
AERODYNAMICS, 1, 2, 3, 4, 40, 41
AEROELASTICITY, 18, 31, 39
AEROSERVOELASTICITY, 28
AEROSOLS, 44
AEROSPACE ENGINEERING, 5
AEROSPACE SYSTEMS, 2
AEROTHERMODYNAMICS, 15, 43
AIR, 4
AIR CARGO, 49
AIR FLOW, 32
AIR LAW, 48, 49
AIR NAVIGATION, 24
AIR POLLUTION, 44
AIR TRAFFIC, 48
AIR TRAFFIC CONTROL, 8, 9, 12
AIR TRANSPORTATION, 9, 12
AIRBORNE EQUIPMENT, 25
AIRCRAFT ACCIDENTS, 9, 10
AIRCRAFT COMMUNICATION, 2
AIRCRAFT COMPARTMENTS, 9
AIRCRAFT CONFIGURATIONS, 10, 16
AIRCRAFT CONTROL, 24, 29, 46
AIRCRAFT DESIGN, 16, 17, 18, 32, 47
AIRCRAFT DETECTION, 45
AIRCRAFT ENGINES, 26, 27, 32, 35, 36
AIRCRAFT EQUIPMENT, 38, 47
AIRCRAFT FUELS, 34
AIRCRAFT GUIDANCE, 13
AIRCRAFT INDUSTRY, 38
AIRCRAFT LANDING, 29
AIRCRAFT MAINTENANCE, 1, 3
AIRCRAFT MANEUVERS, 17, 45
AIRCRAFT MODELS, 15

AIRCRAFT NOISE, 7
AIRCRAFT PARTS, 38, 47
AIRCRAFT PERFORMANCE, 8, 13, 29
AIRCRAFT RELIABILITY, 19
AIRCRAFT SAFETY, 8, 9
AIRCRAFT STABILITY, 15
AIRCRAFT STRUCTURES, 5, 16, 17,
    18, 19, 34
AIRCRAFT TIRES, 15
AIRFIELD SURFACE MOVEMENTS, 8
AIRFOILS, 3, 5
AIRFRAMES, 3, 19
AIRLINE OPERATIONS, 8, 9
AIRPORTS, 1, 10, 12, 31
ALGORITHMS, 2, 9, 37, 41
ALUMINUM, 35, 38
ALUMINUM ALLOYS, 35
ANGLE OF ATTACK, 7, 13, 30
ANTISKID DEVICES, 5
APPLICATIONS PROGRAMS (COM-
    PUTERS), 20, 44
ARMED FORCES (FOREIGN), 22
ASTRODYNAMICS, 11
ATMOSPHERIC CHEMISTRY, 6
ATMOSPHERIC MODELS, 29, 44
ATMOSPHERIC TURBULENCE, 29
ATTACK AIRCRAFT, 18, 21
ATTITUDE (INCLINATION), 11, 29
ATTITUDE CONTROL, 27
AUTOMATIC PILOTS, 29, 34
AUTONOMY, 11
AVIONICS, 4, 24, 25
AXISYMMETRIC BODIES, 6

## B

BALANCING, 17, 21, 26
BELL AIRCRAFT, 13
BIBLIOGRAPHIES, 7
BINARY DATA, 23
BLADE-VORTEX INTERACTION, 3, 7
BLUNT BODIES, 6
BONDED JOINTS, 35
BONDING, 16
BOUNDARY LAYERS, 47

## C

C-17 AIRCRAFT, 20
CALIBRATING, 13

CAVITATION FLOW, 42
CENTRIFUGAL COMPRESSORS, 39
CERTIFICATION, 13, 20, 22
CHAOS, 37
CIVIL AVIATION, 10, 40, 48
COCKPITS, 11, 45
COLLISION AVOIDANCE, 45
COMBAT, 2, 19
COMBUSTION CHAMBERS, 25
COMMERCIAL AIRCRAFT, 8, 40
COMPLEX SYSTEMS, 32
COMPOSITE WRAPPING, 31
COMPOSITION (PROPERTY), 34
COMPRESSIBILITY EFFECTS, 4
COMPRESSIBLE FLOW, 4
COMPRESSIBLE FLUIDS, 4
COMPRESSOR BLADES, 35
COMPRESSORS, 35, 38, 39, 40, 41, 46
COMPUTATIONAL FLUID DYNAM-
    ICS, 2, 4, 15, 17, 34, 36, 40, 41, 42,
    43
COMPUTER AIDED DESIGN, 5
COMPUTER AIDED MANUFACTUR-
    ING, 5
COMPUTER NETWORKS, 5
COMPUTER PROGRAMS, 16, 20, 32,
    42
COMPUTER TECHNIQUES, 32
COMPUTERIZED SIMULATION, 4, 6,
    14, 37, 38, 46
CONFERENCES, 4, 14
CONGRESSIONAL REPORTS, 9
CONSTRAINTS, 45
CONTROL EQUIPMENT, 17, 29, 41
CONTROL SYSTEMS DESIGN, 7, 29,
    33
CONTROL THEORY, 46
CONTROLLABILITY, 16, 28, 29
COPPER, 34
CORRECTION, 13
CORRELATION, 36
COST EFFECTIVENESS, 39
COST REDUCTION, 3, 18, 19, 24, 27,
    32
COSTS, 18, 19, 22, 26, 32, 47
CRACK CLOSURE, 16
CRACK PROPAGATION, 16, 23, 34
CRACKS, 40
CREEP PROPERTIES, 35
CREEP TESTS, 35
CREWS, 45

# Personal Author Index

## A

Adiletta, G., 36
Adyanthaya, V., 48
Ahmed, F., 6
Akimoti, Toshio, 33
Andreev, Anatolij V., 37
Ardema, Mark D., 28
Armando, Patrick, 2
Asher, Greg M., 38
Atkinson, D. J., 44
Avello, C. Garcia, 12
Axeirad, Penina, 11
Azinheira, J. R. C., 12

## B

Babaev, Artashes Eh., 39
Baillie, Stewart, 13
Barker, Thomas, 35
Barnouin-Jha, O. S., 42
Bazarov, Vladimir G., 37
Becker, A. A., 35
Behre, Charles P., 11
Bellero, Lucio, 27
Beltman, W. M., 4
Benney, Richard J., 36
Blanchard, Robert C., 6
Bodstein, Gustavo Cesar Rachid, 3
Bosworth, John T., 30
Bradley, Keith J., 38
Braun, Robert D., 6
Brennan, P. V., 2
Brenner, Marty, 28, 30
Bridel, G., 47
Brooks, C. J., 10
Brooks, Thomas F., 6, 48
Brown, A. D., 25
Bryant, Wayne H., 9
Bullock, R. J., 2
Butcher, Paul, 23
Butzmuehlen, Carsten, 12

## C

Canody, Cheryl, 20
Caputo, Alfredo, 49
Castagnos, Patrick, 22
Castner, Raymond S., 31
Caux, L. A., 47
Cestero, Francisco J., 33
Chaumette, Daniel, 2
Cherry, Mark C., 18
Chumak, Pavel I., 15
Cilia, Joseph, 38
Clark, Robert L., 47
Coleman, John W., 36
Comyn, J., 35
Cooper, Gene R., 36
Corej, Thomas A., 24

Croll, John B., 12
Crowe, C. Robert, 19
Cui, Pingyuan, 5
Currie, A., 2

## D

Damouth, D., 10
Das, I. S., 42
Das, P. K., 39
Davis, R. W., 46
Day, J., 35
De Bortoli, Alvaro Luiz, 3
de Oliveira Soviero, Paulo Afonso, 3
Delaney, R. G., 47
DeMalleray, E., 11
Deng, Zhencai, 5
Deng, Zhidong, 27
Destarac, Guy, 21
Destefani, James D., 38
Dieroff, M., 13
Dixon, Peter G., 31
Dobler, K., 13
Dogliatti, Francesco, 27
Donato, Marina, 48
Dublenko, A. Lawrence, 4
Dunham, J., 41
Dushkin, Andrej L., 37

## E

Ebrahimi, M., 2
Eckhardt, Dave E., Jr., 9
Efremov, Alexander, 28
Ellis, James E., 1
Ershov, Elksei, 42

## F

Feng, Youtian, 27
Finch, Roger S., 20
Fink, Josef, 1
Fleming, J., 10
Fonseca, A. A., 12
Fonseca, Gustavo Farias, 3
Fowler, Ron, 8
Frampton, Kenneth D., 47
Friehmelt, Holger, 22
Fujimori, A., 29
Fung, Francis, 46

## G

Gardner, Lee S., 21
Garimella,, Srinivas, 36
Giannakopoulos, C., 44
Girolami, Claudio, 27
Gmelin, Bernd, 6

Gnoffo, Peter A., 43
Gokdere, Levent U., 40
Gomez De Leon, F. C., 46
Goraj, Zdobyslaw J., 14
Green, P., 10
Gregory, Annie, 5
Griffiths, H. D., 2
Grigor, 37
Guetter, Richard, 22
Guido, A. R., 36

## H

Hahn, Klaus-Uwe, 30
Hanjalic, K., 37
Hardy, Dennis R., 34
Hart-Smith, L. J., 16
Hauvette, Jacquesa, 26
Hazzard, Mark, 22
He, L., 40
Heintsch, Thomas, 30
Herr, Michael, 23
Hess, Ronald A., 29
Hewett, Marle D., 20
Hirata, Miguel Hiroo, 3
Hobbs, S. E., 44
Hoenlinger, H. G., 18
Hollestelle, P. M. N., 24
Horejsi, I., 41
Hozumi, Kohichi, 33
Hu, Hengzhang, 27
Huang, Qingmin, 43
Hughes, Michael C., 21
Hui, Kenneth, 13
Humphreys, William M., Jr., 48
Hunter, D., 10
Hunter, William W., Jr., 48
Hutin, P. M., 18
Hyde, T. H., 35

## I

Immarigeon, J-P., 19
Israeli, D., 21

## J

Jamsek, Damir, 46
Jji, Minggang, 5
Johns, William E., 31
Jonas, Jiri, 34
Jones, Denise R., 9
Jones, R., 44

## K

Katsurahara, Tadashi, 33
Katz, S., 10

# Report Documentation Page

| 1. Report No.<br>NASA/SP—1998-7037/SUPPL374 | 2. Government Accession No. | 3. Recipient's Catalog No. | |
|---|---|---|---|
| 4. Title and Subtitle<br><br>Aeronautical Engineering<br>A Continuing Bibliography (Supplement 374) | | 5. Report Date<br>May 15, 1998 | |
| | | 6. Performing Organization Code | |
| 7. Author(s) | | 8. Performing Organization Report No. | |
| | | 10. Work Unit No. | |
| 9. Performing Organization Name and Address<br><br>NASA Scientific and Technical Information Program Office | | 11. Contract or Grant No. | |
| 12. Sponsoring Agency Name and Address<br><br>National Aeronautics and Space Administration<br>Langley Research Center<br>Hampton, VA 23681 | | 13. Type of Report and Period Covered<br>Special Publication | |
| | | 14. Sponsoring Agency Code | |
| 15. Supplementary Notes | | | |
| 16. Abstract<br><br>This report lists reports, articles and other documents recently announced in the NASA STI Database. | | | |
| 17. Key Words (Suggested by Author(s))<br><br>Aeronautical Engineering<br>Aeronautics<br>Bibliographies | | 18. Distribution Statement<br><br>Unclassified – Unlimited<br>Subject Category – 01 | |
| 19. Security Classif. (of this report)<br>Unclassified | 20. Security Classif. (of this page)<br>Unclassified | 21. No. of Pages<br>72 | 22. Price<br>A04/HC |